AERONAUTICAL ENGINEERING REVIEW

SEPTEMBER 1944

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The Engineer and Society

(A Guest Editorial)

WILLIAM A. M. BURDEN
Assistant Secretary of Commerce

THE SOCIETY of our day is a highly organized and complex structure whose smooth functioning and day-to-day operation are dependent to an almost unbelievable degree upon the specialization of functions among the millions of the world's inhabitants. This is a truism that hardly needs repeating, particularly when it is addressed to the young engineer who has already passed through a highly specialized training and may now be engaged in working upon some even more specialized phase of the profession he has chosen to follow. For it is to the young engineer that I am speaking when I suggest that he cultivate an awareness of the pitfalls lying beyond the phrase "specialization of functions." Engrossed as he may be in the details of his own specific problems, the engineer should not make the mistake of assuming that these details are unrelated to the world about him. He must maintain an awareness of the fact that his individual contribution has a place in the general scheme of things and that the combined efforts of the community have a direction and purpose that cannot be ignored by the individual contributors.

The engineer, just as any other citizen of this world, has a fundamental debt to his society. This debt derives from the fact that his fellow men, by providing him with the needs that justify existence, at the same time provide him with the opportunity to pursue his research or design or construction, as the case may be. In return, his efforts not only must be guided by self-interest and the instinct of self-aggrandizement but must be directed toward the fulfillment of his debt to society by the addition to the welfare of his fellow men. Similarly, in return for the vast store of

accumulated knowledge to which he has been made heir, the engineer must contribute his share to this fund. His efforts must be directed to bear relation to the integral whole of human knowledge and must not be considered an isolated phenomenon, sufficient unto itself, for as such they are meaningless and almost useless.

Dealing as he does with facts and realities, the engineer has come to symbolize for the public the solid foundation of reason and common sense upon which our society must be based. Amid the confusion of war, the clash of ideologies, and the fall of governments, men look to the engineer for a breath of sanity. In his calm, scientific tackling of a constructive job they see promise of realization for their aspirations. Attractive low-cost dwellings, labor-saving devices for the housewife, or a safe and useful personal airplane may be the form their dreams take, but these are merely tangible expressions of a desire for a productive, secure world in which men dedicate themselves to building rather than destruction.

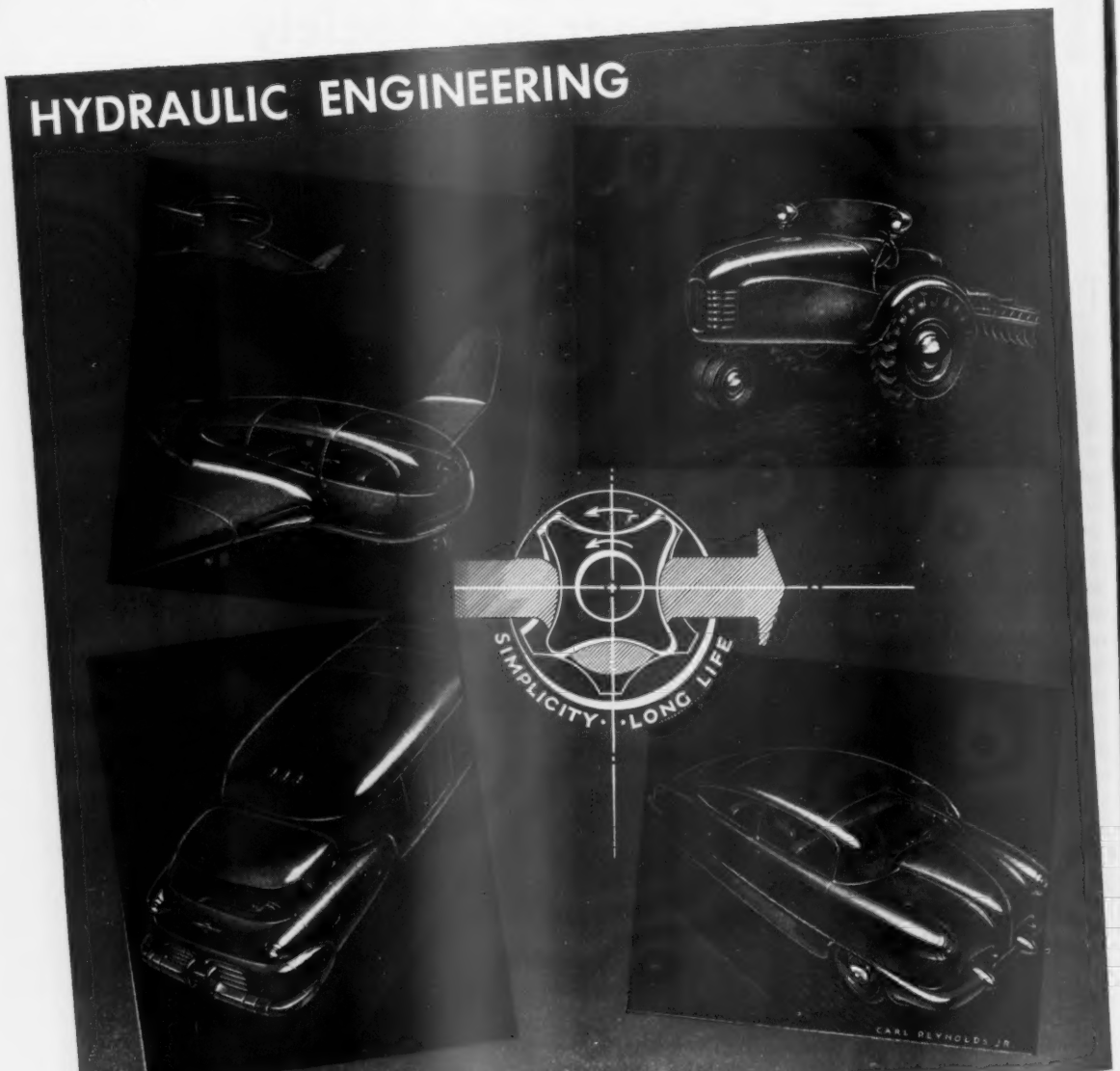
With plain people turning so hopefully to the engineer he, in turn, must encompass them in his horizon. It is not sufficient that he be expertly grounded in some narrow technique while blind to the world in which that technique must function. With such equipment he might call himself a designer, but he should not presume to the title of engineer, a title that associates with itself the integrity of professional status.

The engineer in today's world must understand social, as well as physical, forces. He must know how industry operates and how it fits into the overall economic structure. He must keep pace with changing trends in government and even take part in shaping these trends. He must be an alert world citizen, raising his voice for a social organization that will allow the full development of nature's resources and man's skills.

Above all, he must consider that he has a responsibility to the whole people. He is not working just for himself. He is not working just for his company. He is not working just for the engineering profession or the aviation industry. He is working for the benefit of his nation and, beyond that, of all mankind.

Through such bodies as the Institute of the Aeronautical Sciences, individual engineers are more and more recognizing the importance of sharing their knowledge with, and in return gaining knowledge from, their fellows in the profession. It is vital that the young engineer engage in this professional interchange. He must learn, finally, to share his wisdom with fellow members of society at large and to derive from them a wisdom broader than that attainable by any individual alone or than that contained in any one profession.

HYDRAULIC ENGINEERING



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Unit Cabins to Increase Comfort of Light Aircraft

KENNETH B. TURNER*

Universal Moulded Products Corporation

ABSTRACT

It is suggested that the cabin of a light plane be treated as a unit in the airplane's construction, so as to overcome noise and other discomfort in the typical current light plane and at the same time obtain design and production advantages.

Sources of noise in the typical present design of light aircraft are considered, and particular means of sealing the cabin from such discomfort are discussed, together with a plan for adding good heating and ventilation. Estimated weight and cost penalties in so doing are enumerated.

The idea is advanced that separation of the cabin from being integral with the aft fuselage will permit weightsaving by allowing the use of lighter column material in the latter. Production will also be aided by segregation of the exacting and special work necessary in designing aircraft cabins.

INTRODUCTION

FLYING IN PRESENT LIGHT AIRCRAFT is accompanied by unpleasant noise and vibration in general. If the light plane is to have a wide practical appeal, it must offer greater comfort. This could be obtained to a large degree by good soundproofing and vibration damping in the area around the occupants, particularly by the adoption of what will be called a "unit cabin"—a soundproofed structural unit.

Use of the unit cabin idea with a typical current design will demonstrate principles that could be applied to new designs. The general ideas presented in this paper would require the substantiation of practical test data for each particular design case.

In discussing cabin comfort, noise and vibration will be the main issues, while ventilation and heating will be considered the secondary problems.

PRESENT CABIN TREATMENT IN LIGHT PLANES IN RELATION TO COMFORT

Weightsaving and economy have dictated many of the design features of present-day light aircraft. Fig. 1 shows a typical current design of the light airplane. Components are enumerated in the order of the lessening of their detrimental effect on comfort in the plane's cabin. A discussion of these items will show what conditions they cause in the cabin. Item 1, including the engine, propeller, and engine cowl, is the major generator of noise and vibration. Its usual position in the front of the airplane puts it in a good place to transmit discomfort to the cabin. It transmits its noise and vibration by two methods: by directly vibrating adjacent parts which also form the inside of the cabin such as Item 2, the fire wall and back cowl, and by propagating sound in the air outside the cabin to come in through Items 3, 4, and 5. These last three items, windshield and windows, door, and floor, may also respond directly in resonance with the engine at particular frequencies and the sound is transmitted reinforced. Items 6, 7, and 8 are usually of relatively minor importance, particularly as to engine noises. The baggage compartment, which is often a light box or sling, may resonate if only a simple box or be an ineffective sound barrier if simply a sling. However, sound coming up from the back of the plane is not noticeable. Fuselage covering panels nearly always vibrate at a pitch that is not uncomfortable. The fuselage structure may transmit noises of the controls and tie wires attached to it, but usually such noises are unimportant compared to engine noise. The noise that the fuselage structure can carry, however, is uncomfortably demonstrated by a tail skid scraping along a paved runway. Fortunately, this source of noise is becoming obsolete.

Of nearly equal importance to engine noise are noises caused by the air itself rushing past parts of the airplane. Items 3 and 4, windshield and windows and doors are most affected from this cause, although many parts can be set vibrating audibly in the air stream. Leaky windshields, etc., cause whistling, which is usually more uncomfortable than lower-pitched noises of higher intensity.

Entrance to the cabin of noises from sources just discussed is common on typical light planes. The result is that communication in the cabin without apparatus or without shouting is nearly impossible, loud-speaker radio reception and audio warning devices are not practical, and travel is fatiguing.

DEMANDS OF THE FUTURE LIGHT CRAFT

In the future when there is much competition to offer the best product, attempts will be made to increase cabin comfort. It should be possible to talk at the same level as in an air liner.

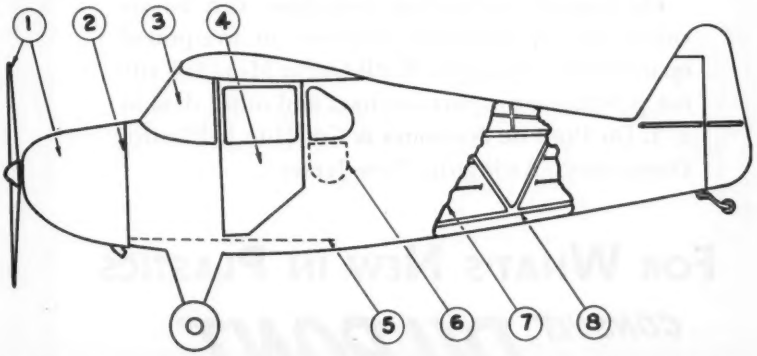

FIG. 1. Components important to comfort for a typical light airplane. (1) Engine, propeller, and cowl, (2) fire wall and back cowl, (3) windshield and windows, (4) door, (5) floor, (6) baggage compartment, (7) fuselage covering, (8) fuselage structure.

Presented at the National Light Aircraft Meeting, I.A.S., Detroit, April 27–28, 1944.

* Engineer, Bristol Aircraft Division.

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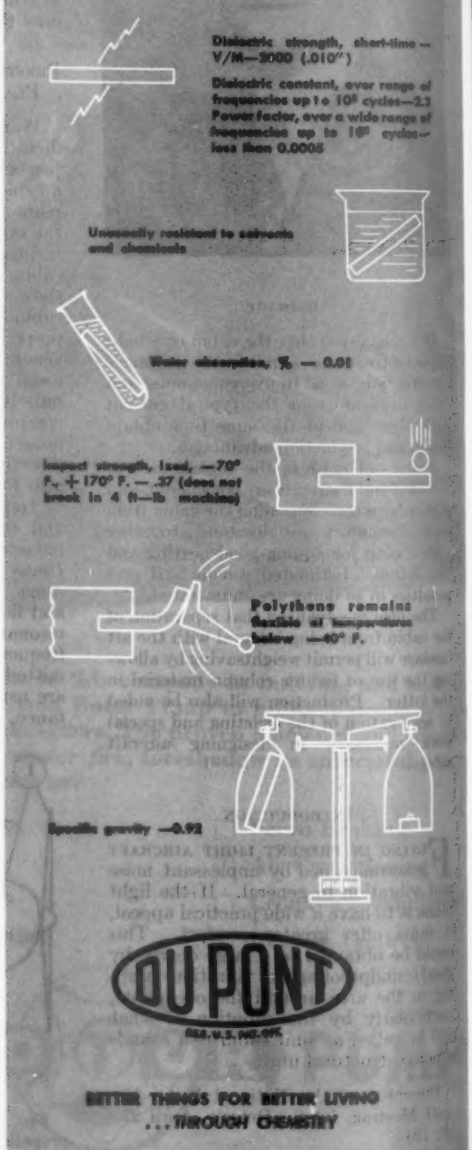
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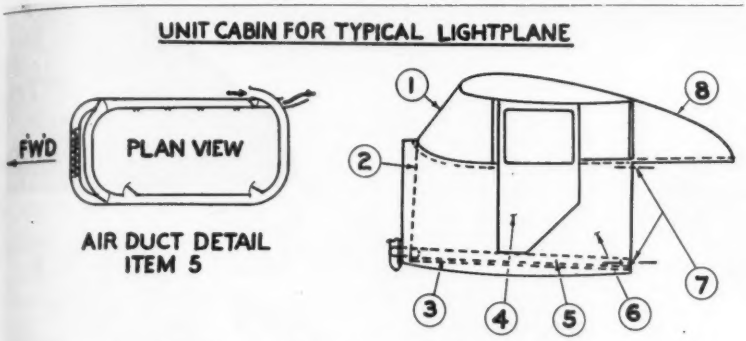

FIG. 2. Estimated weight and cost penalties: Unit cabin vs. typical integral cabin.

Item	Name	Estimated weight added	Estimated cost added
1	Windshield and windows	5.6#	$ 8.40
2	Front sound shield	5.0	5.00
3	Floor	3.0	5.00
4	Door	...	...
5	Air duct	5.0	15.00
6	Rear sound shield	3.8	4.80
7	Aft fuselage attachment fittings	4.0	8.00
8	Rear windows	...	...
	Miscellaneous	5.0	5.00
	Total	31.4#	$51.20

Radio loud-speakers and microphones should permit easy exchange of signals and pleasant broadcast reception. A good heating and ventilation system should be made in conjunction with the sealing out of noise. It should distribute hot air or fresh air throughout the cabin when needed, ready either for winter or higher altitude coldness.

The most obvious and easiest steps toward improving comfort consist in adding soundproofing to designs as they stand. Sound-absorbing material placed inside the cabin will cut down noise reflected inside the cabin itself. But further steps necessary to keep the noise out in the first place demand special construction in the cabin, which together with other considerations involved in cabin work, to be discussed later, indicate that building the cabin as a separate subassembly could be advantageous.

THE UNIT CABIN

Consideration of the cabin of a light plane as a unit in its design may be a new idea but represents no radical departure from present basic principles. It is a matter of advantageous production breakdown which also can give design advantages.

With the cabin a separate unit, the items shown in Fig. 2 should receive special attention. First, the windshield and windows would be made as airtight and vibration-free as possible. The gauge of all pyralin would be increased to provide rigidity. Flat plates, such as the windows, would be doubled to make 0.125-in. thickness, while curved and naturally stiffer surfaces would be increased to 0.090 in. To obtain airtightness at the bottom of the windshield, a formed wooden bow with a slot for the windshield could be used. The back cowl would be bolted or screwed down to the bow, and a thin plywood shield, Item 2, could be glued to the back of the bow and run down to the floor. This shield would leave a dead air insulation space between the fire wall and the cabin occupants. The floor, Item 3, composed of a light core material sandwiched between plywood skins, would keep out noise from under the cabin, particularly from the engine exhaust. The door, Item 4, would preferably be made out of wood, two plywood skins having hollow sound-deadening airspaces between. All around the edge of the door a sealing strip of sponge rubber will make insulation more complete. One manufacturer of light aircraft has already found that wooden doors quiet its planes noticeably. The windows in the door and throughout the plane should be carefully felted in place.

Ventilating and Heating

Provision for ventilating and heating could be by an arrangement such as Item 5. This air duct can be made of material similar to the air ducts on automobile defrosters—a coiled wire inside impregnated cloth. This material is light and has a sound-absorption value that would allow it to deliver the air without much objectionable noise. The operation of the duct, referring to Fig. 2, plan view, is as follows: For ordinary summer ventilating, valves may be set as shown, with air being scooped in at right rear, going into cabin through valves on left-hand side of cabin and out small vent holes on right exhaust tube. For heating, the heater by-pass may be closed or partly closed as desired, and air circulates through heater indicated by wavy line, then down right side tube, which is now closed at the back so the heated air goes through the vent holes into the cabin.

The rear sound shield closes out the back portion of the cabin from the windows to the floor and also forms part of the baggage compartment. Thus far, no mention has been made of the cabin structure, but no matter what type is used it will be possible to fasten the tail section by four bolts in a location such as is shown for Item 7. The rear window shown is pictured simply because the author feels that the extra visibility gained and the weight saved in doing away with the usual turtle deck is a worthy design feature. If the expense of a large sheet of pyralin boosts cost out of proportion to benefits received, windows can be inserted in part of a cheaper molded material.

The item "miscellaneous" includes

(*Continued on page 23*)

TABLE 1

COLUMN WEIGHT RATIO SPRUCE VS. STEEL

MEMBER \ ITEM†		A SQ. IN.	WGT. #/FT.	ρ IN.	L IN.	L' IN.	L'/ρ	F_c #/SQ.IN.	P_a #	WT. RATIO W'D/ST'L
LARGEST	1" O.D. .065" 1025 STEEL	.191	.649	.331	45	31.8 (C·2)	96.0	25,180	4,800	.55
	1 5/8 SQ. 3/8 SPRUCE BOX	1.188	.360	.535	45	31.8	59.5	2,740*	5,130	
AVERAGE	3/4" O.D. .035" 1025 STEEL	.079	.267	.253	30	21.2	83.9	27,730	2,180	.51
	1 1/8 SQ. 3/16 SPRUCE BOX	.703	.135	.390	30	21.2	54.4	2,935*	2,060	
SMALLEST	1/2" O.D. .028" 1025 STEEL	.033	.141	.167	15	10.6	63.4	31,280	1,032	.54
	5/8 SQ. SOLID SPRUCE	.391	.075	.181	15	10.6	65.0	3,280	1,280	

†SYMBOLS SAME AS ANC-5, 1942. * STRAIGHT LINE FORMULA USED, SINCE NO TEST DATA ON HOLLOW W'D COLUMNS YET.

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ALCOA ALUMINUM

Soundproofing of Military Aircraft

ALBERT A. ARNHYM*

Solar Aircraft Company

SUMMARY

This paper deals with the requirements and problems of soundproofing military airplanes. Two basic methods—namely, primary and secondary soundproofing—are briefly analyzed. The former concerns reduction of noise at its sources, such as propellers, exhaust, engine, and others. The latter consists of the application of soundproofing materials to impede transmission and increase the absorption of noise that has penetrated into, or is generated within, the cabin. Soundproofing materials and methods of using them are described. It is suggested that military airplanes be soundproofed to given weights rather than specified noise levels so as to create as much comfort as possible under existing conditions. The added value of soundproofing in improving the performance of the airplane and in assisting the heating scheme is explained.

INTRODUCTION

CONSIDERING THE IMPORTANCE of weight, space, and other limitations on the military airplane, it is often doubted whether the benefits achieved by soundproofing, no matter how desirable, are such that their lack would result in noticeably decreased efficiency of the flight crew.

This question has been answered convincingly by medical authorities. Although different people are afflicted in different ways, even the young and healthy men of whom military flight crews are composed are not immune to the effects of the earsplitting noise existing in an airplane cabin. The acuity for tones of high pitch is affected first and almost immediately. After lengthy exposure, such as on long bombing missions, the sensitivity for sounds of lower frequency begins to decrease also. Certain letters, then words, are misunderstood or not heard at all. The volume of the radio receiver must be increased and direct conversation becomes practically impossible.

Obviously, this progressive deafness is a serious handicap in receiving landing instructions, following the aural radio guide beam, or conveying vital messages over the intercommunication system during combat, bombing runs, and landing. Further problems are the physical fatigue and nervousness caused by exposure to excessive noise and vibration and the permanent damage done to the hearing of flight personnel.

For these reasons, soundproofing should be considered as one of the most essential comfortization features on military aircraft and incorporated whenever possible.

MEASUREMENT OF SOUND

The laws pertaining to sound are quite different from those relating to most other phenomena in physics, which often makes them difficult to understand let alone apply correctly. The greatest stumbling block in this respect is the measurement of sound, which, however, is the basis for sound control or soundproofing.

The Decibel

Noise cannot be measured by means of a unit like the inch or volt since the range of audible sounds is extremely large. The intensity of a loud sound is about 2.5×10^{13} greater than that of a sound that can be barely heard. In addition, sound cannot be measured by itself but only by comparing it to another sound of known intensity.

Therefore, if I_x is the intensity of an unknown sound and I_a the intensity of one which is known, the ratio I_x/I_a is the basis for sound measurement. Since, as stated before, the range of this ratio is too great for convenient use, a logarithmic unit has been adopted which equals ten times the Briggs logarithm of the intensity ratio and is called the decibel or, abbreviated, db. It is expressed by the formula db. $= 10 \log (I_x/I_a)$.

Offhand, this unit appears too complicated to be practical. However, matters are facilitated by the fact that there is general agreement on the reference intensity I_a, which has been adopted as 10^{-16} watts per sq.cm. Thus, if a noise level is said to amount to 70 db., it means that the logarithm of the intensity of this noise minus the log of the reference intensity is 7, because 10 times 7 is 70.

The use of the decibel is further enhanced by the fact that the human ear also adds sounds logarithmically and that one decibel is just about the smallest change in noise intensity which it can detect. In addition, the agreed-upon reference level is close to the threshold of hearing. Therefore, a little study of the decibel will quickly make its use a simple matter.

Noise Levels

According to the definition of the decibel, the absolute value of a sound intensity is of no importance unless there is a reference intensity. For instance, if the intensity of one sound is twice as great as that of another one, the decibel difference between the two noise levels is always 3 db., no matter what the values of the intensities are, because:

$$\text{db.} = 10 \log (2/1) = 10 \times 0.3 = 3$$

In other words, if the intensity of a noise is doubled, its level is increased by only 3 db. By the same token, if its intensity is cut in half, the level is reduced by not more than 3 db. As a practical example of this phenomenon it shall be assumed that two airplane engines produce a combined noise of 110 db. Now, one of the engines is stopped, yet the level has dropped merely 3 db. or only three times the minimum change in intensity which the human ear can detect.

Consequently, reduction or even total elimination of one or a few noise sources has little if any effect, and only simultaneous reduction of all causes of noise can achieve worth-while results. This frequently doubted fact can be proved by making the audience in a theater clap their hands with equal effort. Then half of them are asked to stop clapping, yet the reduction in noise level is not very great—namely, only 3 db. Now the experiment is repeated but, instead of half of the audience stopping to clap, the entire audience reduces the effort with which they clap, and now the reduction of the noise becomes very noticeable.

A graphic illustration of this relationship is given by the curves in Fig. 1, which provide a method for adding decibels. If, for instance, a noise of 60 db. is to be added to one of 40 db., 60 db. on the abscissa and 40 db. on the ordinate yield lines that intersect on the curve marked "0.05." This amount must be added to 60 so that 60 db. plus 40 db. equals 60.05 db. In other words, the contribution of the 40 db. noise source is negligible. This applies equally to reductions so that the often claimed fabulous noise reductions achieved merely by means of mufflers in

Presented at the Airplane Design Session, Twelfth Annual Meeting, I.A.S., New York, January 25–27, 1944.

* Consulting Engineer.

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Indianapolis, Indiana

Every Sunday Afternoon
GENERAL MOTORS SYMPHONY OF THE AIR—*NBC Network*

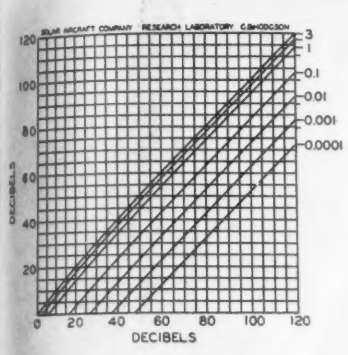


Fig. 1. Chart for the addition of decibels.

the airplane exhaust or silencing of one among many other noise sources are purely imaginary.

Principles of Soundproofing

The magnitude of the task of soundproofing military airplanes becomes evident by a comparison of the levels of noise, comfort, and speech in various places and conveyances (Fig. 2). The six comfort levels CL-1, CL-2, etc., denote the ranges within which noise is normally felt as very comfortable, comfortable, slightly uncomfortable, uncomfortable, very uncomfortable, and, finally, painful. By the same token, the six speech levels SL-1, SL-2, etc., apply to the effort with which conversation can be carried on and designate whisper, normal, raised voice, very difficult, shouting, and impossible.[1]

As can be seen, the noise level in a soundproofed, twin-engined air liner is about 80 db., which means that the comfort level is from comfortable to slightly uncomfortable and conversation requires a somewhat raised voice. On the other hand, lack of soundproofing in a multi-engined warplane raises the noise level to about 120 db., which not only makes conversation impossible but is felt as painfully loud.

In order to achieve a tolerable noise level, such as 85 db., a reduction of about 35 db. is necessary. So great a reduction requires an elaborate soundproofing installation that demands more weight than could be spared on a military plane.

The solution to this problem lies in dividing soundproofing into two phases —namely, primary and secondary soundproofing. The former consists of reducing all of the principal causes of noise by proper design or redesign of the sources. The noise that still exists after that is then dealt with by secondary soundproofing or the installation of soundproofing materials.

Primary Soundproofing

Primary soundproofing must contribute a reduction of at least 10 to 15 db. to make the entire scheme worthwhile. This is by no means impossible and requires merely close cooperation between the soundproofing engineer and the various design groups.

The main sources of noise on an airplane in the usual order of their magnitude are propellers, exhaust, engine, and aerodynamic, air-borne, ventilating and miscellaneous noises.[2]

Propeller Noise

An approximate figure for the noise created by a three-blade, metal propeller can be found by the formula:

$$\text{noise level (db.)} = 19 + 0.11\ V$$

in which V is the tip speed in ft. per sec. As the tip speed approaches that of sound, the noise becomes exceedingly loud, which, in addition to the discomfort for the crew, indicates reduction of propeller efficiency and permits easier detection by the enemy. Consequently, there are three reasons for keeping the tip speed as low as possible and, preferably, below 800 ft. per sec.

Other factors in dealing with propeller noise are its directional characteristics, which create a zone of maximum noise a few feet forward and aft of the propeller plane. Therefore, the clearance between propeller tip and fuselage must be at least 12 in., and no stiff or rigid sections such as doors and windows should be placed within the zone of maximum noise.

Exhaust Noise

The exhaust contributes almost as much, and sometimes even more, noise than the propeller. Proper location of the exhaust at maximum distance from the fuselage and in such a manner as to prevent exhaust gases from striking it not only decreases the noise but improves the operation and service life of the airplane. Well-designed manifold and exhaust systems further enhance these purposes. The Solar manifold assembly shown in Fig. 3 is a typical example of such a construction.

Engine Noise

Engine noises may be direct or indirect. The former are created by the operation of accessories, such as tappets, valves, gears, and the like. Usually, they are not serious and can be ignored, particularly if the engine is located in a nacelle at some distance from the fuselage. However, in this case it is necessary to baffle the leading edge so as to prevent transmission of such noises into the fuselage.

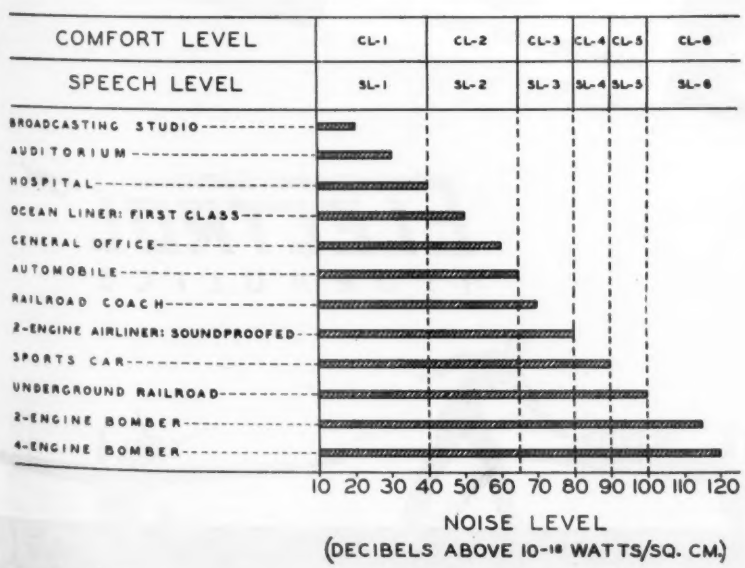
Indirect engine noises are those caused by drumming parts that have been set into vibration by transmission from the engine. These noises can be reduced considerably by proper engine suspension, which again has advantages in addition to noise reduction.

Miscellaneous Noises

Aerodynamic noises are caused by the flow of fast moving air over the airplane and its components. Proper aerodynamic design not only decreases avoidable noise but also the drag on the plane.

Air-borne noises are those that originate during flight and are usually due to inefficient design of either the fuselage or accessory equipment. The elastic structure of the airplane tends to encourage vibrations in flight unless stressed parts, large panels, and webs are properly located, suspended, and stiffened. Similarly, rattling accessories can not only nullify the best soundproofing scheme but are either badly designed or not securely fastened. Here again, control of noise and vibration goes hand in hand with improved performance and service life, since it requires better suspensions and shock absorbers.

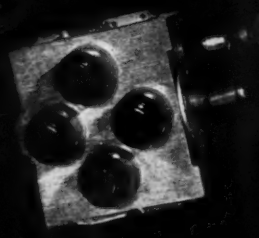
Ventilating noises are mainly caused by incorrect design of the heating and ventilating system or by excessive air speeds through ducts and inlets. Much noise may also be contributed by various accessories such as auxiliary engines and machine guns. These noises can be



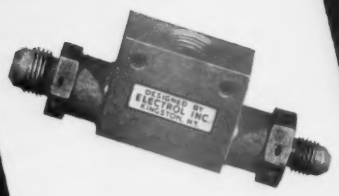
Photograph Courtesy Pitman Publishing Corporation

Fig. 2. Levels for noise, comfort, and speech in various places and conveyances

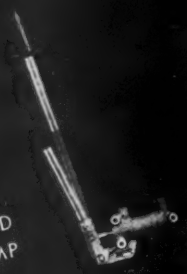
DEPENDABILITY



SELECTOR VALVE



SHUTTLE VALVE



HAND PUMP

UNLOADER VALVE

CHECK VALVE

LANDING GEAR CYLINDER

MAIN PRESSURE RELIEF VALVE

TAIL WHEEL CYLINDER

WING LOCK CYLINDER

ELECTROL
HYDRAULICS

ELECTROL INCORPORATED, KINGSTON, NEW YORK

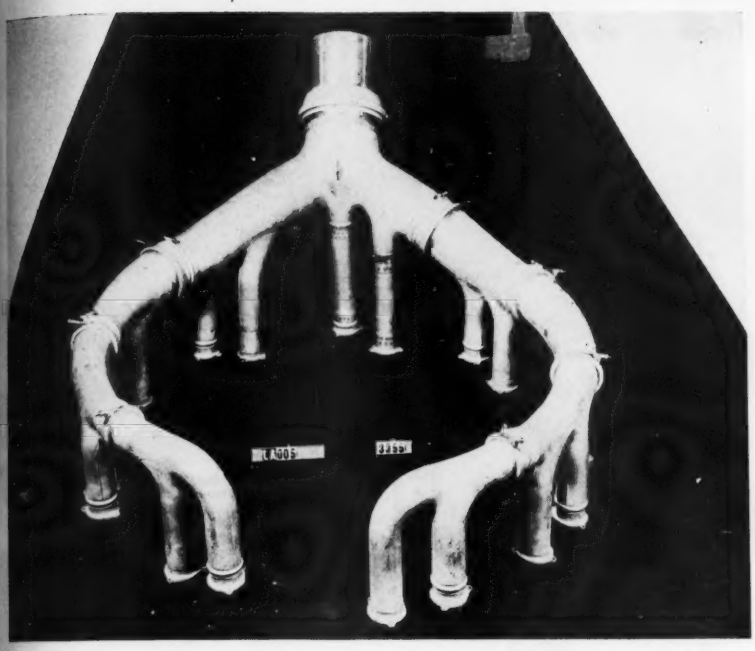


FIG. 3. Solar manifold assembly.

reduced in two ways—namely, by holding the manufacturer of the accessory equipment to specified noise levels and by placing inherently noisy equipment outside of soundproofed spaces, properly shock-mounted. This applies particularly to machine guns near the flight deck or control cabins which, when firing, make it practically impossible for pilot, navigator and bombardier to concentrate on their delicate and vital tasks.

It becomes evident that primary soundproofing must start with the first drawing of a new plane. If properly applied throughout, it will prove to be beneficial for more than mere reduction of noise and should therefore be an integral phase of the design of every airplane, no matter how small or how big.

SECONDARY SOUNDPROOFING

Secondary soundproofing must reduce the noise level that still exists after the primary phase to the level of reasonable comfort. This is accomplished by impeding the transmission of noise into the cabin and by absorbing whatever noise has penetrated into or is generated within the cabin. Since this entails the application of suitable materials to the walls and ceiling, secondary soundproofing is not feasible on cockpit type of planes but can be readily employed on all planes with closed cabin.

Because of the peculiar nature of sound, even the smallest opening in the fuselage admits an amount of noise which is entirely out of proportion with its size. Since the military plane contains a great number of large openings, such as for the disposition of military equipment, ventilation, placing of sights, and others, it is obvious that the outside noise can enter almost entirely unimpeded. Design for reduction of noise transmission, which is mandatory in the commercial air liner, is therefore out of the question for the military plane. However, this does not apply to the damping of vibrations and reduction of drumming which can be achieved by treating the panels in the skin and bulkheads with sound damping materials.

The major portion of the secondary phase is taken care of by noise absorption, which is accomplished by covering walls and ceiling with suitable materials. Their purpose is to trap the sound waves that strike them in millions of diminutive air pockets and convert the sound energy into heat. As a result, the noise inside the cabin is not reflected back and forth between the walls—which is called reverberation—but is absorbed and killed.

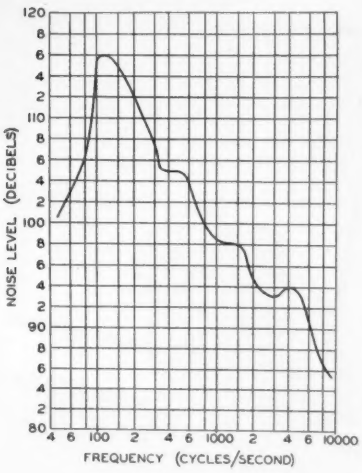
Soundproofing Materials

Soundproofing materials for aircraft must meet innumerable specifications. Before all, they must have high absorbing power at very little weight and over a wide range of frequencies. As can be seen in Fig. 4, which shows the frequency distribution of noise on the average aircraft, most of the noise has a frequency of about 100 cycles per sec. and gradually tapers down with increase in frequency.[3] Unfortunately, the characteristics of the common soundproofing materials are exactly opposite—that is, their greatest absorbing power lies above 1,000 cycles per sec. and decreases rapidly with frequency.

In addition, soundproofing materials must be easy to flameproof without losing their properties. They must be highly moisture repellent, vermin-proof, stable, easy to apply and ship, and, finally, have good thermal insulation values so as to serve a dual purpose.

The nearest approach to such an ideal are the materials using kapok as a base. Kapok is a fluffy, light material that can be readily flameproofed and has excellent sound- and heatproofing properties.[4] Usually combined with cotton and wool, kapok products are available in a variety of forms and shapes for the soundproofing of aircraft.

Fig. 5 shows sound absorption coefficients at different frequencies and for various thicknesses of "K" Felt, which is manufactured by the American Felt Company and consists of 40 per cent kapok, 30 per cent cotton, and 30 per cent wool. It has good acoustic and thermal properties, although "K" Felt, as well as other materials of this type, is a rather poor sound absorber at the lower frequencies that were shown to dominate on aircraft. On the other



Photograph Courtesy of Flight *Magazine*

FIG. 4. Frequency analysis of noise levels in an airplane cabin.

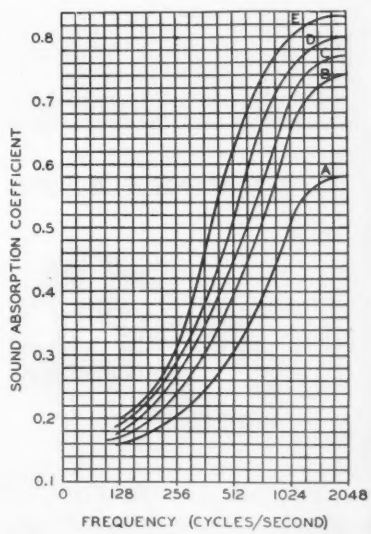
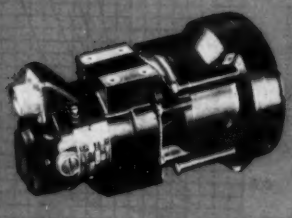


FIG. 5. Sound absorption coefficients for various thicknesses of "K" Felt. (Curve A, 3/16 in. thick; B, 1/4 in.; C, 5/16 in.; D, 3/8 in.; E, 1/2 in.)

DUMORE AEROMOTORS SERVE IN MANY CAPACITIES

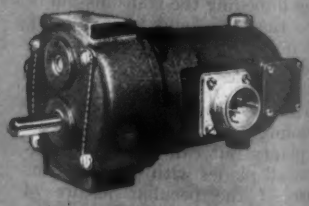


COWL FLAP MOTOR

Regulates flow of cooling air through engine compartments; important to efficient operation.

FLARE RELEASE MOTOR

Used on Martin Mariner to release flare bombs.



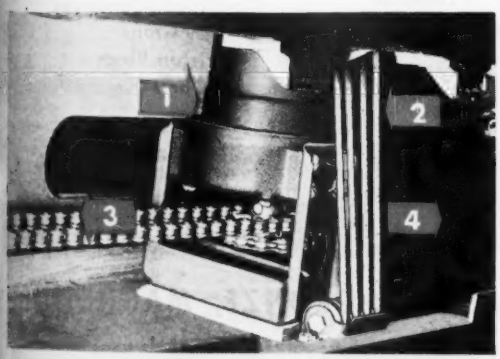
INTERCOOLER DOOR MOTOR

Aids the P-47 Thunderbolt to reach exceptionally high ceilings, by operating in conjunction with supercharger intercooler.

EASY, JOE!"

Cadets setting her down easy for a first solo landing are really "sweating it out" on a test they anticipate with apprehension and look back on with relief! Once past this test they feel they are "on their way", but they still face hours of landing practice to perfect this fundamental, though all-important operation. Constant landing imposes a greater workload on the wing flaps, or air-brakes of trainer planes than they ever receive on other plane types—and each wing flap part must be designed to take this extra strain.

The Dumore Wing Flap Motor designed for the Cessna AT 17 Bobcat bomber trainer is an example of a part designed for service "beyond the normal call of duty". It does the job. The basic Dumore motor has been distinguished for a quarter-century by quality construction and dependable performance. Special features, such as drive or control elements, enclosures and protective devices, have been developed by Dumore engineers to meet the specific requirements of individual aircraft applications. These features combine with a basic motor to comprise a well-coordinated, compact, efficient power unit. Bearing, lubrication and commutation are conditioned to assure reliable operation at all flying levels and over a temperature range of—65° to 160° F. Unified responsibility, simplified assembly and service, and more efficient operation are among the advantages offered builders and operators alike. Dumore engineers will gladly aid you to apply Dumore Motors to your designs. Ask for the Aeromotor Catalog, with full specifications and engineering data—write today to The Dumore Company, Motor Division, Dept. MJ10, Racine, Wisconsin.



1. Dumore Wing Flap Aeromotor
2. Rudder Cables
3. To Left Wing Flap
4. To Right Wing Flap

DUMORE WING FLAP MOTOR, E1Y1P

Illustration shows the motor, mounted in the center of the fuselage of a Cessna AT17 Bobcat, driving the wing flap mechanism through roller chains. Impregnated, sintered iron reduction gears are self-lubricating at temperatures down to—65° F. Ball bearings lubricated with grease approved for similar low temperatures. Totally enclosed, and supplied with AN connector. Can be furnished with built-in magnetic clutches and brakes.

FOR *Extra* POWER HOURS

MK15

DUMORE

HEADQUARTERS FOR FRACTIONAL HORSEPOWER MOTORS

Air Power Through Piston Rings

McQUAY-NORRIS
ALTINIZED
PISTON RINGS

PISTONS . . . PINS . . .
HARDENED AND GROUND PARTS

More and more, the leading makers of aircraft motors are using McQuay-Norris precision parts. Our 34 years' experience in precision manufacture, our long and intensive work in metallurgy, heat treating, clinical research and laboratory experiment, enable us to turn out the sturdy, dependable parts demanded by modern aviation. Your inquiries are invited.

PARTS FOR AIRCRAFT ENGINES
Piston Rings
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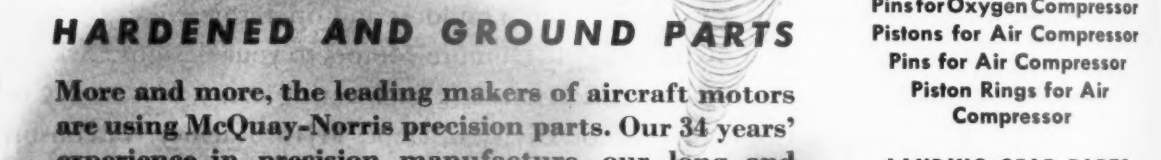
Piston Pins
Counterweight Cheek Pins
Machined Magnesium Parts
Cylinder Hold Down Nuts
Hardened and Ground Parts

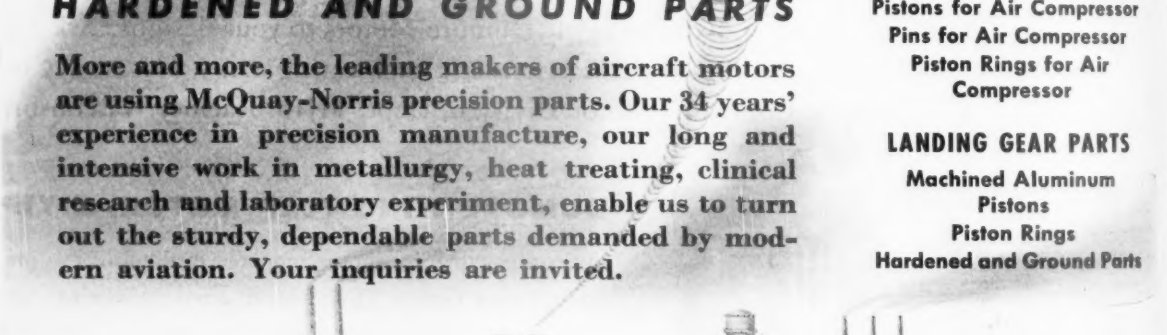
PARTS FOR PROPELLER ASSEMBLY
Machined Magnesium Parts
Piston Rings

EQUIPMENT FOR MAINTENANCE OF AIRCRAFT
Pistons for Oxygen Compressor
Piston Rings for Oxygen Compressor
Pins for Oxygen Compressor
Pistons for Air Compressor
Pins for Air Compressor
Piston Rings for Air Compressor

LANDING GEAR PARTS
Machined Aluminum Pistons
Piston Rings
Hardened and Ground Parts



PRECISION WORKERS IN IRON, STEEL, ALUMINUM, BRONZE, MAGNESIUM



McQUAY-NORRIS MFG. CO. (AIRCRAFT DIVISION), ST. LOUIS, U. S. A.
CANADIAN PLANT, TORONTO, ONTARIO

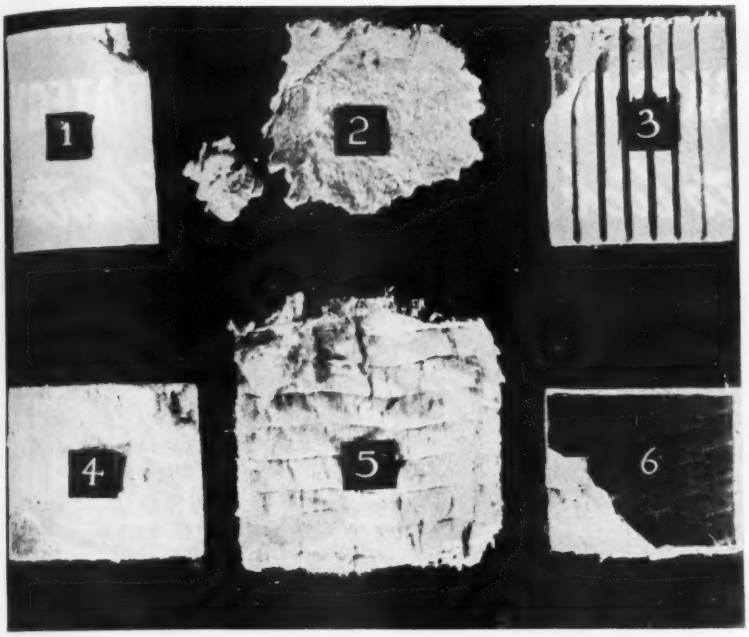


FIG. 6. Samples of Seaman aircraft insulation material.

hand, even at these frequencies kapok is superior to similar materials.

The variety of applications to which kapok lends itself is illustrated in Fig. 6, which shows several of the products of the Seaman Paper Company. The numeral (1) denotes a piece of the well-known Seapak, which is particularly suited as damping material; (2) is a highly flexible kapok blanket; (3) is corrugated Seapak, which, because of its construction, is quite efficient in the low-frequency range; (4) is a piece of Sky-felt, a felted product consisting of kapok, wool and cotton, which is suitable for floating blankets; (5) is the widely used Kwilko, a fluffy kapok batt sewed between cheese cloth; and (6) is a panel of kapok felt covered with a cockpit liner.

Lately, manufacturers have brought on the market soundproofing materials made from fiber glass, asbestos, and synthetics that are said to excel kapok in many ways. It can be expected that further developments will ultimately create products that closely approach the ideal material for aircraft insulation. However, even now, the designer has a sufficient choice to soundproof satisfactorily a military airplane at acceptable weights.

Soundproofing Methods

It is of the greatest importance to select not only the most suitable material in each particular case but also the most suitable combination—a requirement that is often overlooked with the result that the installation is both too heavy and utterly inefficient.

Slight vibration and drumming of panels can be minimized by simply spraying on a liquid, sound-deadening paint. If vibrations are more serious, a layer of Seapak or felt is cemented to the affected panel. In some cases thin sheets of mica or similar materials are used. As the vibration becomes severe and more absorption is required, this treatment is augmented by a blanket of felt, Kwilko, or the like, which is installed in such a manner as to leave an airspace of about 1-in. depth.

This construction is shown in Fig. 7. Contrary to thermal insulation, there is relatively little known about the exact function of the airspace other than that it tends to dampen out low-frequency noise. This property is highly desirable in view of the fact that the soundproofing materials in themselves help little in counteracting the low-frequency peaks of airplane noise.

There are two problems in connection with this design.[1] First, the question

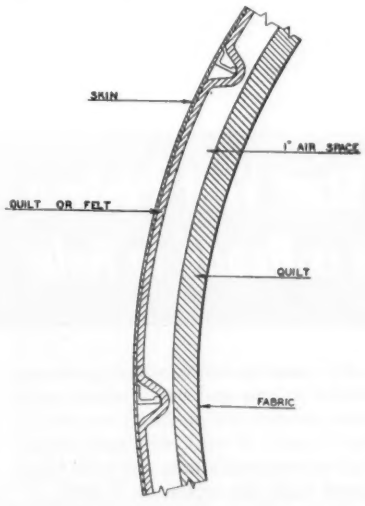


FIG. 7. Cross section through soundproofing installation with 1-in. airspace.

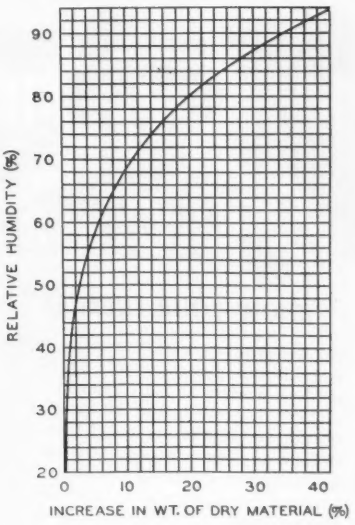


FIG. 8. Weight increase of "K" Felt with increase in relative humidity.

arises as to whether the fabric on top of the installation should be an impervious material—such as a doped lining, leatherette, etc.—or a porous cloth—such as cotton. The former is more desirable from the standpoint of stiffness, appearance, illumination, heatproofing, and servicing. However, it is extremely poor as a sound insulator, since it reflects the sound waves back into the cabin rather than permits them to enter the noise-absorbing pores in the soundproofing material behind it. For this reason, cover fabrics for soundproofing installations of this type should always be porous.

The second problem concerns the trapping of moisture within the installation. Condensation of water vapor on the soundproofing materials will not immediately penetrate them, since they are highly water-repellent, but usually there is no place to repel them to and the condensed moisture remains trapped. After a while, the moisture-proofing agent becomes dissolved and the materials soaked; this not only destroys their sound- and heatproofing properties but increases their weight unreasonably. Fig. 8 shows the increase in the weight of "K" Felt with increase in relative humidity, which is quite considerable. Over a period of time, the overall increase may amount to as much as 25 to 35 per cent of the original weight. For this reason, airspaces must always be properly vented and the condensed moisture be permitted to drain out readily.

Returning to methods of soundproofing, Fig. 9 shows a further elaboration of the previous method. A blanket of felt or quilt is inserted between the outer and inner layers and in such a manner as to float freely and to create two airspaces of 1-in. depth each. This method is employed where vibrations and low-frequency noise are particularly severe and great noise reduction is necessary.

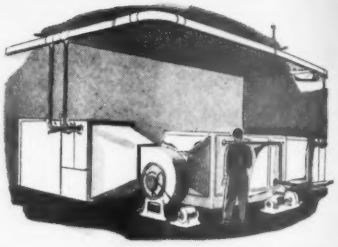
IT TAKES BATTLE-SEASONED STRATEGY *to lick Winter's Icy Blasts*

"KNOW YOUR ENEMIES"

NO GENERAL WINS BATTLES today without skillfully deploying *all* branches of modern warfare at his command. "Logistics"—it's called. And the logistics of heating and ventilating must be brought to bear to wage *and win* your annual battle against besieging icy blasts. For instance—sneak attacks by cold air at loading platforms, infiltration of drafts at wide window areas . . . call for special defense tactics. Shape and size of the room, height of the ceiling, paths of possible heat travel, fume control factors . . . all must be accounted for—if you are to lick the "chilly" enemies of comfort *at minimum cost to your fuel supply.* Here's an outline of Sturtevant's battle-seasoned strategies *you* can *draft* to conquer winter's dictatorship . . .

HOT BLAST CENTRAL HEATING

Here's your infantry . . . it's tops for maintaining uniform, work-productive temperatures over large, generally unobstructed interiors. A fan speeds heat from extended surface coils through continuous heat distributing ducts equipped with outlet vents spaced for proper distribution. Air may be continually recirculated—or, in the event appreciable volumes are exhausted in fume or dust control, supplemented with outside air.

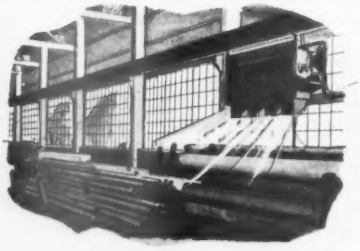


COMBINED HEATING and VENTILATING

Aerial support may be necessary for the hot blast central heating equipment. Positive fresh air ventilation is accomplished by exhausting stale air—fume, dust or fog—and inducting equal quantities of outside air. For optimum processing and working conditions, air washers, filterwashers or electric precipitrons take care of air cleaning; and humidification is obtained inexpensively by the inclusion of air washers and automatic controls.

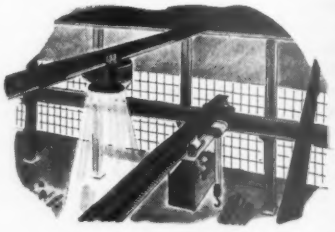
SPEED HEATER

Call on this "commando" to kill "cold spots" anywhere! . . . or to take over the job of heating the entire plant . . . in low or moderate height ceiling areas. It is a horizontal propeller fan type—with capacities up to 300,000 btu per hour. Spotted around the plant, it provides *balanced* heat—bringing normally frigid zones around doors, windows and the like within the "comfort zone."



MULTIVANE HEATER

Need some heavy artillery? This large-volume unit heater evenly blankets large areas with precision, "range control" nozzles. It has a centrifugal type fan—and develops up to 1,000,000 btu per hour. May be installed on wall, floor or ceiling. Automatic controls are available to "mix" heated and unheated air, maintaining nozzle discharge temperature at any desired degree.



DOWNBLAST HEATER

And here's your dive bomber! It offers the perfect solution for hard-to-heat areas—where heat flow is hampered by high ceilings, partitions, shelving or equipment. A vertical propeller fan discharges up to 400,000 btu per hour *downward* at high velocity. Installations at heights of 30 feet or more are practical because the heat waves mushroom off the floor flooding the working areas.

The Time is Ripe to Start Your Postwar Planning—*Sturtevant is Ready to Help!*

If you've been limping along with makeshift heating and ventilating systems . . . or, if you want to effect *new* economies in cost and *new* highs in production efficiency to better your peacetime competitive position—*now is the time* to start postwar planning. Sturtevant is ready to work with you or your planning committee to get *engineered air* recommendations *down in black and white*—ready for budget approval—and ready for action on V-day!

B. F. STURTEVANT COMPANY • *Hyde Park, Boston 36, Mass.*

Sturtevant

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Puts Air to Work

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Engineered for Efficiency in

Heating
Ventilating
Air Conditioning
Dust and Fume Control
Pneumatic Conveying
Vacuum Cleaning
Mechanical Draft

Weight Considerations

The selection of materials and methods can be done in two ways, depending on whether the designer must meet a specified noise level or a specified weight. It should be emphasized that it is practically impossible to meet specifications for both weight and maximum noise level unless the presoundproofing noise levels and predominant frequencies in various parts of the cabin have been ascertained during test flights and the specification writer has the necessary empirical data on which to base his calculations for weights and noise reduction. This procedure is usually recommended only for commercial planes in which a comfortable noise level must be attained under all circumstances. In military planes it is preferable to establish the maximum weight that can be sacrificed for soundproofing comfort and make the best of it. Experience has shown that reasonable soundproofing can be attained on military aircraft by allotting about $^1/_4$ to $^1/_2$ per cent of the gross weight.[5]

Once this weight is given, it must be appropriately distributed over the areas that are to be soundproofed, taking into account maximum noise zones, probable predominant frequencies, and the need for more or less soundproofing in individual places. Assuming that a weight of 30 lbs. has been assigned to a particular compartment which has a total soundproofing area of 120 sq.ft., then the average unit weight of the material cannot exceed 0.25 lb. per sq.ft. The selection of the best suitable combination and types of materials to meet this condition is the deciding factor in providing either little, if any, relief or the greatest comfort for the crew possible under the circumstances.

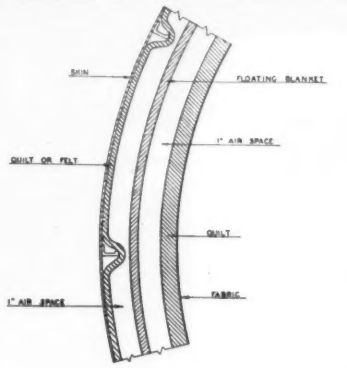

FIG. 9. Cross section through soundproofing installation with two 1-in. airspaces.

Unreasonably small weight allotments may just as well be canceled altogether because a soundproofing installation that is to be designed within such weights has less effect than a piece of cotton in the ears of the crew members and weighs much more. By the same token, it would be senseless to allot generously 100 lbs. for the soundproofing of a four-engined bomber but demand, in turn, that the designer make the cabin as silent as a grave, although the required noise reduction may have to be anywhere from 20 to 50 db.

In allotting weight it should also be remembered that a soundproofing installation has great thermal value and will decrease the weight of the heating equipment. However, the insulation should, as a rule, not be designed from the standpoint of thermal values, since a good soundproofing installation is usually also an equally good heat insulator, while the opposite is not always true.

Thus, soundproofing serves more than one purpose inasmuch as the primary phase benefits the operation of the airplane and the secondary phase the heating scheme. But even the mere reduction of deafening noise to a level of tolerable comfort should be grounds enough to grant a reasonable amount of weight, no matter how badly it is needed otherwise. It is true that 100 lbs. represent over 15 gal. of fuel or 300 rounds of ammunition for an 0.50-caliber machine gun. But if the tired ears of the pilot cannot hear the radio beacon that is to guide him home or the gunner does not understand the warning shouted over the intercommunication phone, then 100 lbs. denied for a soundproofing installation may mean the loss of the entire plane and its irreplaceable crew.

References

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[2] Zand, Stephen J., *Comfort in Air Travel*, Journal of The Royal Aeronautical Society, July, 1936.

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[5] Arnhym, Albert A., *Comfortization of Military Aircraft*, Part IV, Aero Digest, November, 1942.

(*Continued from page 11*)

sound-absorbing materials placed inside the cabin, sleeves placed on controls, sealing strips, etc.

Also in Fig. 2, the comparison of the unit cabin versus the typical integral cabin as to cost and weight, the typical cabin is assumed to be without any special soundproofing. Actually, if some soundproofing were used, the comparison would not be so unfavorable. Then the fittings, which are of small cost and weight, would be a bigger part of the difference. In the estimates the costs are figured as well as their changing nature permits, and weights are taken from approximate areas. The totals will show the proper magnitude of factors involved.

Weightsaving

An important possibility from the design standpoint is the saving of the weight that the improved unit cabin required by redesigning the aft fuselage for better weight efficiency. This can be done as shown in Table 1 by using a wood truss construction. The largest and longest tube in a current size light plane is about 1 in. in diameter with an 0.065-in. wall. The material is 1025 steel. This steel tube could be replaced by a spruce box section about $1^5/_8$ in. square with $^3/_8$-in. web and flanges to make a weightsaving of about 50 per cent. If tube by tube the aft section of the fuselage was replaced by wooden column members, a weightsaving of nearly 50 per cent might be effected. If the weight of fuselage structure is taken as 15 per cent of the empty weight of the airplane, and the aft section of the fuselage as half of the fuselage structure, then for a plane of empty weight of 900 lbs., approximately 3.8 per cent weight could be saved or about 34 lbs. Allowing 4 lbs. for gusseting and extra fittings beside main attachment, approximately 30 lbs. could be saved. This is about the same magnitude as weight added by the unit cabin.

Production Advantages

Besides the design advantages, there are production advantages to the unit cabin. The type of labor required for finishing work on cabin interiors, installation of controls, and locating and adjusting special equipment makes it feasible to separate this work from operations requiring less care and skill, and less floor area is tied up. Production scheduling is assisted by this breakdown. Much of the optional equipment for light planes is contained in the cabin: extra instruments, special radio equipment, special interior finish, extra tanks, pumps, etc. It would be advantageous to work on the cabin as a unit separate from more standard units.

Thus the unit cabin offers advantages similar to those obtained in the automobile industry by separate bodies, where production is facilitated and a quiet, comfortable enclosure is provided for the occupants.

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Packaged Power

FREDRIC G. ROHM*

The Aviation Corporation

ABSTRACT

The history of the independent automotive engine manufacturer is briefly summarized, and the present status of the aircraft engine manufacturer is compared with that of the automotive engine manufacturer in the early twenties. It is implied that, if the independent engine manufacturer is to survive, he must provide a superior and cheaper product. A typical airplane-engine installation, the troubles encountered therewith, and the steps taken to correct such difficulties as cooling, distribution, and service failures are described in detail. It is shown that the engine manufacturer not only is greatly concerned about such items but is better equipped to provide initially a correct and more workable design. Further, the essentials can be provided in a "packaged unit" ready for installation by the airplane designer.

INTRODUCTION

AT THE BEGINNING of World War II the organizational structure of the Aircraft Industry resembled somewhat that of the Automotive Industry of the middle twenties. A relatively few engine companies supplied power plants to a relatively large group of airplane manufacturers. It is to be assumed that this type structure will exist immediately after, and for some time after, World War II.

During the late twenties and the early thirties many of the smaller automotive manufacturers either went out of business or were absorbed by larger companies. The total yearly output of automobiles steadily increased. This condition should have greatly increased the business of the independent engine manufacturers. That this was not the case is a matter of record. A great majority of the automobile manufacturers built their own engines, while the formerly successful independent engine companies were forced to go into specialties in order to survive. These engine specialties *took the form of industrial, marine and aircraft engines* which represented a small percentage of the total or dollar volume engine business.

The question naturally arises as to why a group of independent companies, enjoying the majority of the country's business, would, in the course of several years, suddenly find itself with a small part of its former business. It is the opinion of many people that the automobile companies would not have gone into the engine business had they been supplied with a superior product at a cost equal to, or less than, that for which they themselves could manufacture the same product.

It seems reasonable to assume that at the present time the airplane manufacturer knows little or nothing about the engine manufacturing business and vice versa. As long as the aircraft-engine manufacturers can supply the aircraft manufacturers with a superior power plant and at a cost equal to or less than the aircraft companies can themselves build power plants, it seems logical that the independent engine companies will continue to exist as separate units. *The aircraft companies probably will not be interested in building engines.*

A lot of the responsibility for building a superior, low-cost engine rests upon the shoulders of the engineer. Simplification of design, improvement in service life, and increase of power-weight ratio all are vital functions of the engineer which tend to provide the necessary superior and low-cost engine. The final selling price of the power plant depends directly upon the design and the manufacturing methods.

Engine Cost

The actual cost of an engine, as far as the customer is concerned, may be divided into two parts—namely, the initial cost and the service upkeep costs. No matter how low the initial costs may be, the service upkeep costs may be so great as to make the engine a really high-cost job, as well as to ruin the reputation of its producer. This paper will attempt to present an idea that the author believes will not only protect the aircraft engine from a great number of service ills, with resultant decreased upkeep costs and increased prestige for the engine builder, but will also supply the aircraft industry with a much better, more economically operated, and more easily installed power plant.

HISTORY

A year or so ago an airplane was designed which, when experimentally tested, showed none of the troubles common to prototype airplanes. The Lycoming 0-290, four-cylinder, 125-hp. engine was chosen as the power plant. All calculated performance figures were met or exceeded during the prototype tests. No difficulties with engine cooling were experienced. In fact, the engine cooled and performed so well that it appeared as though a so-called "perfect" installation of an engine had been achieved. Many production models of this airplane were made and flown during the following fall, winter, and spring. No service difficulties were experienced in a great many operating hours.

Then, during midsummer, a group of these planes, located in the southwestern part of this country, were reported to have suddenly developed serious ailments. These reports stated that valves were sticking, engine operation was ragged and erratic, and bad overheating of cylinder heads with resultant piston scoring was occurring regularly. The trouble seemed to be prevalent to a greater or lesser extent in all planes of this model and in this particular area. The troubles were confined neither to recently delivered planes nor to planes that had seen considerable service. As soon as these events began occurring a Service Engineer was sent out to find the trouble. After a number of days of work it became apparent that the problems were of a type that should be studied in the laboratory. This decision seemed most logical when it was found that a number of airplanes, manufactured by a different company, but with the same model Lycoming engine, were operating satisfactorily and without troubles in this same area.

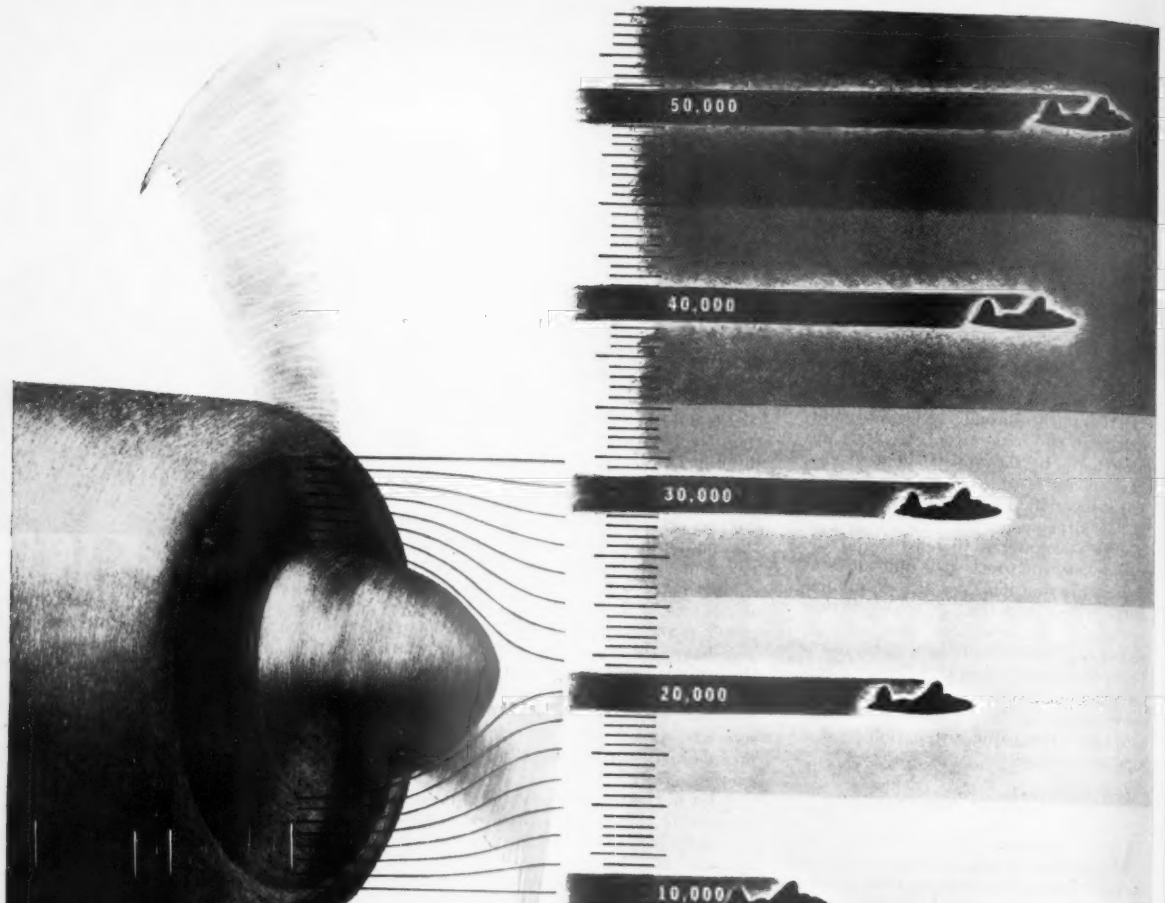
FLIGHT TESTS

One of the airplanes was delivered to the Lycoming Division for observation. Since the troubles seemed associated with a hot temperature condition, the airplane engine was thoroughly warmed until maximum allowable cylinder head temperatures were reached at take-off. The engine was stopped for about 10 min. between the first landing and the proposed second take-off.

While checking the ignition before the proposed second take-off, it was discovered that operation was ragged when

Presented at the National Light Aircraft Meeting, I.A.S., Detroit, April 27-28, 1944.

* Supervising Engineer in Charge of Air-Cooled Engine Research and Development, Lycoming Division.



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attempting to run on single ignition, either magneto. Engine speed dropped off over 1,000 r.p.m. on single-ignition operation and firing was intermittent. Switching to dual ignition did not help the condition once the ragged operation had started. It was found that the engine could be brought back to normal operation on dual ignition either by running at idle for a short period and then going to full throttle or by simply leaning out the mixture without altering the throttle position. Single-ignition operation was possible only on a leaner mixture. The ambient air temperature at this time was 95°F.

The following day the ambient air temperature was slightly over 100°F. The plane was flown at a low altitude with the engine operating at full throttle for about 15 min., during a flight on this day. Switching to single ignition caused erratic engine operation during this flight, rather than the normal operation experienced the previous day. This seemed further proof that the troubles were related to the hot ambient air temperature.

Cylinder Temperatures

During all flights it was noted that the two front cylinders ran extremely cool, while the two rear cylinders ran extremely and dangerously hot. This was quite a contrast to the evenly cooled cylinder pattern obtained on the prototype tests. It, therefore, could easily be understood why piston scoring had occurred on some engines.

Furthermore, an examination of the exhaust manifolding immediately disclosed that the left front cylinder exhaust was greatly restricted by a poorly designed junction of the front stack and the exhaust runner. A check on service records revealed that all exhaust valve sticking and burning had occurred on the cylinder located in this position. Removal of the restriction by a little hand reworking resulted in a slight lowering of the cylinder head temperature of this cylinder but did not change in any respect the other malfunctioning conditions.

The following day the ambient air temperature had dropped to 85°F. Engine operation was perfectly normal under all flight conditions and the ground test work, except that the rear cylinders still ran hot while the front cylinders were cool. As 85°F. is the normal temperature of the locality in the vicinity of the Lycoming Division Plant during midsummer, it was decided to continue the test work in the laboratory where temperature conditions could be controlled at will. The engine, with all its accessories including its propeller and the nose section of the airplane, was set up on a test stand.

Fuel Temperature

It was found that all previous ground test malfunctioning could be reproduced by varying the ambient air temperature in the test cell. It was further noted that at 125°F. ambient air temperature on dual ignition, the engine operation gradually became more and more erratic, lost speed, and finally stopped altogether.

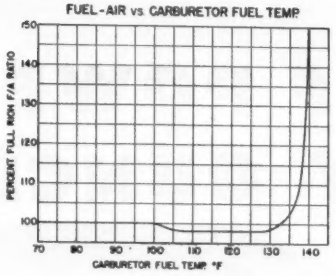

Fig. 1.

Since a leaner mixture strength had corrected erratic single ignition operation during flight tests, it was felt that the fuel flow of the carburetor might, in some way, be enriched by hot temperature conditions in the vicinity of the carburetor fuel bowl and the gascolator. *The temperature of the gasoline in the carburetor fuel bowl was measured as 138°F., with an ambient air temperature of 120°F.* By inserting a small heat exchanger between the gascolator and the carburetor the fuel temperature could be controlled over wide limits. It was soon found that, regardless of ambient temperature conditions, erratic or normal single-ignition operation could be reproduced at will by raising or lowering the carburetor fuel temperature. The dividing point between erratic and normal operation appeared to be 138°F.

The results of this investigation are shown in Fig. 1. A study of this curve reveals that the fuel-air ratio was normal over the temperature range of 70° to 98°F. and was about 2 per cent low from 98° to 128°F., becoming normal again at 133°F. However, the fuel-air ratio rapidly increases from this point on, showing a 20 per cent enrichment at 138°F. and a 55 per cent enrichment at 140°F. Above 143°F. the fuel-air ratio became so rich that the mixture would no longer fire, and the engine, of course, stopped.

An investigation of this condition of fuel flow variation with fuel temperature

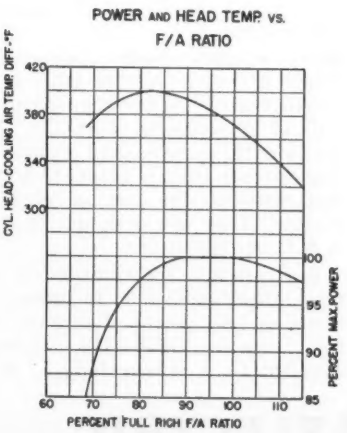

Fig. 2.

was also made on a carburetor flow bench. With this setup fuel-air ratio measurements could be made at a higher fuel temperature, since the test was not limited by engine stoppage. The curve produced on the air box was almost identical to that shown in Fig. 1 and indicated about 200 per cent enrichment at 145°F. The enrichment in fuel-air ratio was caused by gas vapor formation over the gasoline in the carburetor float bowl. This vapor found its way into the engine via the bowl vents. When the bowl vents could no longer pass the vapors fast enough the float bowl pressure increased, thereby causing the balance of the carburetor to be upset and the main jet to pass more fuel. This progressed rapidly until the fuel-air ratio was too rich to support combustion. *Enlarging the bowl vents to four times their normal areas extended the range of normal engine operation only a few degrees and involved such radical carburetor setting changes that a corrective approach from this angle was impractical.*

Mixture Distribution

It might be assumed at this point that all that became necessary to correct the erratic engine operation was to make an installation change providing enough cool air blast over the carburetor, gascolator, and fuel lines to keep the carburetor float bowl temperature below 138°F. This would be a logical assumption if the erratic operation had occurred at 141°F. where the fuel enrichment is 100 per cent or greater. It is not logical, however, at 138°F. where the enrichment is 20 per cent. Normal engine operation can be obtained at enrichments somewhat above 20 per cent. After a careful study of the curve shown in Fig. 1, *keeping in mind the very uneven head temperatures already noted*, it was decided that the mixture distribution to the cylinders must be poor and that the front cylinders probably were having delivered to them a fuel-air ratio so rich as to cause them to misfire, while the fuel-air ratio at the rear cylinders probably was lean, causing them to overheat.

Tests made during the development of the Lycoming 0-290 engine showed that good mixture distribution was being attained. It was therefore assumed that some peculiarities due to engine installation must exist which upset the mixture distribution. Opposed to this argument, however, was the fact that mixture distribution apparently was good when the ambient air temperatures were low.

Hypothetical Case

In order to clarify just how this trouble was analyzed, a review of the effect that various fuel-air ratios have on the power output and the cylinder head temperature of a single cylinder is in order. Fig. 2 shows curves of cylinder-head temperature, as indicated by a spark-plug gasket thermocouple, and brake horsepower plotted against fuel-air ratio. In order to compare directly data of a similar nature used

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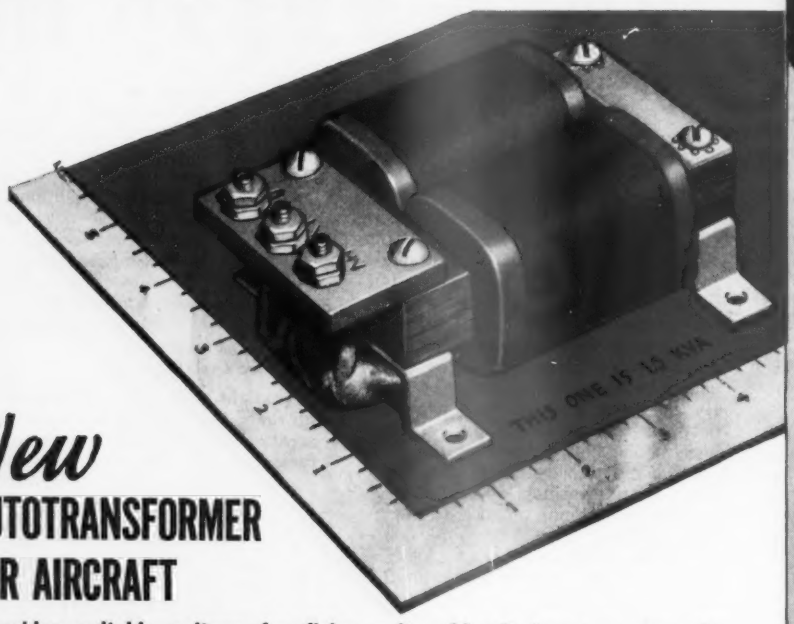

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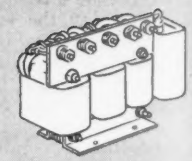

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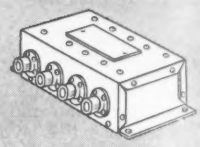

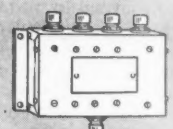

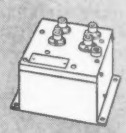

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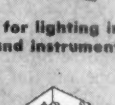

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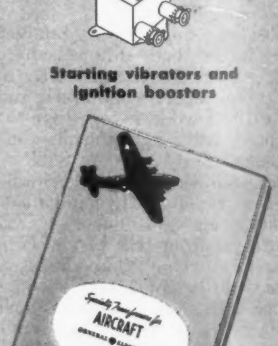

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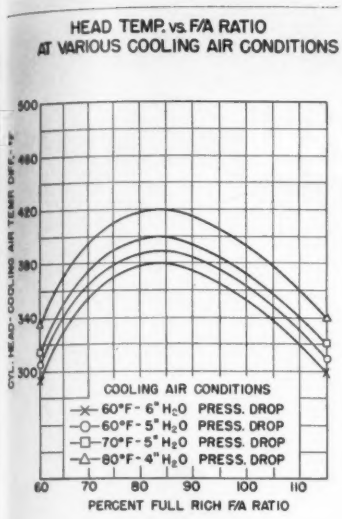

FIG. 3.

in this paper, the units chosen for plotting are as follows: Temperature is plotted as the difference between observed spark-plug gasket temperatures and ambient air temperature. The power unit is plotted as a percentage of the power obtainable with a best power fuel-air ratio. Since the normal full rich carburetor setting chosen for use with the O-290 engine is slightly richer than necessary for best power, the fuel-air ratio units were chosen as a percentage of the full rich fuel-air ratio. The choice of these units eliminates the effect of air density changes on the power output and confines the curves to power changes due to increase or decrease in fuel-air ratios only.

The curves on Fig. 2 were obtained when no preignition or detonation was occurring during engine operation. It will be seen that peak cylinder head temperatures occur at 81 per cent of full rich fuel-air ratio, while best power is attained at 92 per cent of full rich fuel-air ratio. Also, on this cylinder, peak temperatures occur when the power output has been reduced to 96.5 per cent of its best power value by use of a leaner fuel-air ratio. During this test the cooling air pressure drop across the cylinder was 6 in. H_2O and the cooling air temperature was 60°F.

Effect of Varying Cooling Air Temperature

Fig. 3 shows clearly the effect on cylinder-head temperatures at various fuel-air ratios when different cooling air temperatures and pressure drops across the cylinder are used. A study of this set of curves reveals that the general shape of the cylinder-head temperature is unchanged and that an increase of cooling air temperature of 10°F. causes a 10°F. rise in cylinder-head temperature, while a decrease in cooling air pressure drop of 1 in. H_2O causes an increase in cylinder temperature of 10°F. at any particular fuel-air ratio.

On a multicylinder engine it is not unusual to find unequal pressure drops across the individual cylinders and unequal cooling air temperatures above the cylinders. As an example, let us assume that Fig. 3 is a four-cylinder engine, each curve representing the temperature of one cylinder of the engine. An analysis of these curves would then lead to the belief that the mixture distribution to each cylinder was identical, since all curves are perfectly parallel. If it were possible to make all cylinders have identical cooling characteristics, to attain perfect mixture distribution, and to control pressure drops and air temperatures above the cylinders to an equal value, then all of the cylinder-head temperature curves would coincide and the cylinder-head temperature pattern of a multicylinder engine would appear as that shown in Fig. 2.

As far as is known, identical cylinders and these conditions have never been attained, so the best that may be done is to attempt to approach the type curve shown in Fig. 2 as nearly as possible. Indeed, a pattern such as shown in Fig. 3 is so much better than is usually attained that it could very well be used as a model exemplifying the ideal curve.

As a second step in this explanation, the expected cylinder-head temperature patterns of a multicylinder engine having both unequal cooling air distribution and unequal mixture distribution should be studied. If, for instance, two

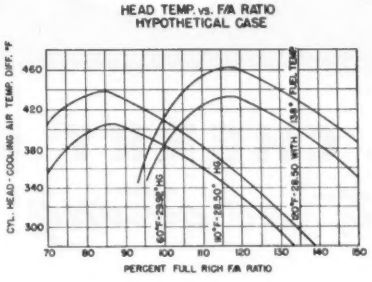

FIG. 4.

cylinders of a four-cylinder engine had delivered to them a mixture strength rich enough so that their peak temperatures occurred at about 85 per cent of their average full rich fuel-air ratio and that the remaining two cylinders had delivered to them a mixture strength such that peak temperatures were reached at about 115 per cent of their average full rich fuel-air ratio, the cylinder-head temperature patterns would be similar to those shown in Fig. 4. *This condition sets up an interesting cooling problem.*

Air Density Effects

In order to intelligently analyze Fig. 4 it is necessary to review the effect of various air densities on the fuel flow characteristics of a carburetor. Most light plane engines are equipped with a carburetor that does not have automatic air density compensation. Many tests made on carburetors of this type show that extreme sea-level changes in air temperature or pressure have little or no effect on the full throttle fuel flow characteristics of the carburetor. These tests therefore have shown that the full throttle fuel flow of a carburetor of this type remains a practically fixed value and that changes in air density serve to increase or decrease the mixture strength delivered to the engine. This type carburetor is given a setting so that the engine receives the desired fuel-air ratio at conditions of standard air density.

Referring to Fig. 4, it will be seen that this hypothetical engine, if run at standard air density (100 per cent full rich fuel-air ratio), would have little temperature spread between its various cylinders and could be assumed to be a well-cooled engine if no other facts were known, the maximum spread of temperature between cylinders being 20°F. The actual maximum cylinder-head temperature in this case would be about 470°F., and the installation engineer would probably consider his work well done. During summer operation on a day when the air temperature is 110°F. and the barometric pressure is 28.50 in. Hg., the temperature maximum spread between cylinders becomes 100°F. The two rich cylinders now have become cooler and the two lean cylinders are operating at their temperature peaks. If the prototype plane with this engine had been flown on such a day, the installation engineers would have been concerned about the cooling problem because now the maximum actual cylinder-head temperature has become 570°F.

Furthermore, under the same barometric conditions but with a 120°F. ambient air temperature and 138°F. carburetor bowl temperature, the fuel-air ratio would be enriched to 136 per cent of its original value and the maximum temperature spread between cylinders would then have become 210°F.

Actual Case

A test of the nature just described was conducted on the engine using all original accessories, propeller, and nose section of the airplane. Fig. 5 shows the results of this test. It can be seen that this installation produced a cylinder-head temperature pattern similar to the hypothetical case. The prototype plane test was conducted in the fall of the year, and it is easily understood

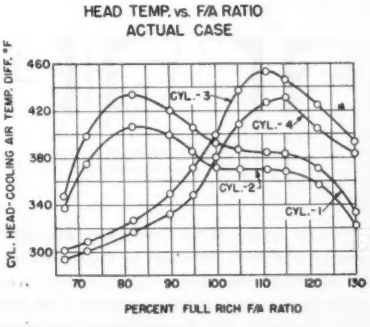

FIG. 5.

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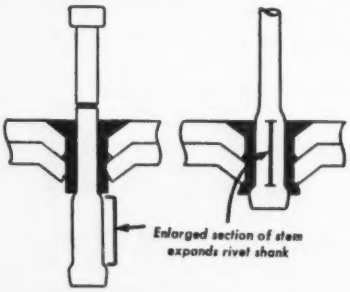

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why the cooling of the engine was approved. This type curve does not show the actual fuel-air ratio in each cylinder and gives only an indication that the fuel distribution is unequal. However, the actual tests showed that under hot ambient air temperature conditions the two front cylinders stopped firing altogether, indicating about a 200 per cent enrichment in these two cylinders. The problem then became one of finding what had upset the mixture distribution so violently.

The Exhaust Manifold

Attacking the problem in a different manner by keeping the carburetor fuel bowl temperature in the range where no enrichment from excessive fuel temperature was introduced, it was found that manually increasing the fuel-air ratio would produce the same erratic running condition at 85°F. ambient air temperature. It, therefore, was decided that fuel temperatures under 130°F. and ambient air temperature and pressure were only contributing factors, the real cause for the trouble being uneven fuel distribution.

It was decided that a visual analysis of the exhaust flame color would aid in providing the next angle of the attack. The exhaust manifolds were replaced by short exhaust stacks for this study. It was soon discovered that the fuel-air ratio could be increased up to 180 per cent of its full rich value, without malfunctioning, by use of short exhaust stacks. A mixture distribution curve was made using cylinder-head temperature patterns as the indicator with the results shown in Fig. 6. This curve compared favorably with the hypothetical one shown in Fig. 3. Without going into the technicalities of how it was accomplished, results of the exhaust manifold investigation showed that the original exhaust manifolds caused a tuning resonance to be set up in the induction system which, in turn, caused rich fuel mixtures to be delivered to the front cylinders and lean fuel mixtures to be delivered to the rear cylinders.

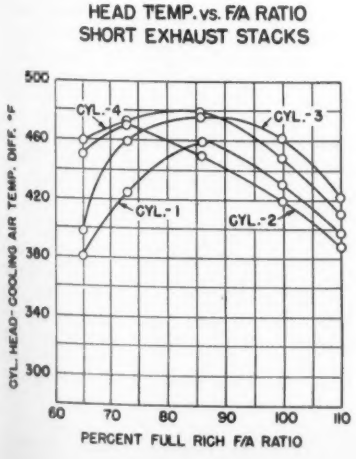

Fig. 6.

A set of exhaust manifolds were then developed to give the same characteristics as short exhaust stacks and, at the same time, to fit in the same position as the original exhaust manifolds. Fig. 7 shows the cylinder-head temperature pattern obtained when using the Lycoming designed exhaust manifolds. It will be noted that these manifolds compare favorably to exhaust stacks (Fig. 6) and to the hypothetical curve shown in Fig. 3.

Carburetor Air Box

Knowing that the design of a carburetor air box greatly influences the general fuel or mixture distribution of an engine, it was decided to investigate the air box used on the installation under investigation. Rather than go through a large series of tests on the original carburetor air box, an air box of known characteristics was substituted in its place. This air box of known characteristics was developed by Lycoming Division after some sad ex-

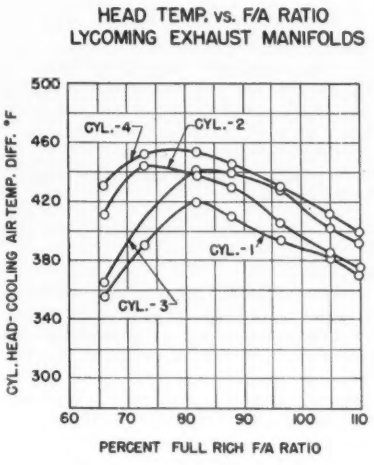

Fig. 7.

periences with the majority of types of air boxes used in airplane-engine installations. It was found that the majority of carburetor air boxes greatly upset the fuel flow characteristics and the fuel distribution characteristics of a carburetor. They also had a rather high built-in restriction that further reduced an engine's power output possibilities. As a matter of fact, it was rather usual to find distribution almost as bad as that shown in Fig. 5 due entirely to air box design.

Using the Lycoming design exhaust manifolds and the Lycoming carburetor air box on the engine, a test was run, the results of which appear in Fig. 8. Comparison of this curve with Fig. 7 shows that the maximum temperature spread between cylinders has been reduced from approximately 40°F. to approximately 20°F. and that rate of change of cylinder-head temperature with change of fuel-air ratio is much more constant. This indicated that the

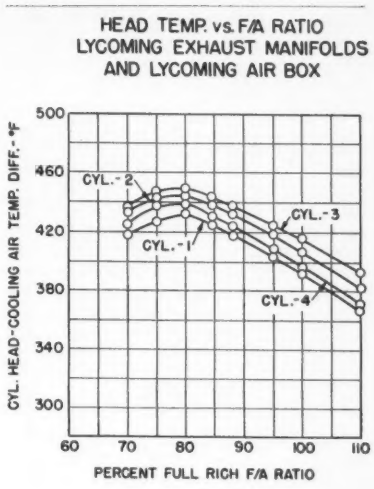

Fig. 8.

fuel or mixture distribution to the cylinders has been improved.

Air Box Design

It should be stated here that the air box supplied with this particular airplane was a good one compared with those usually supplied. It only slightly disturbed the mixture distribution. Its chief fault was that it caused an enrichening of the normal carburetor fuel flow amounting to 4 per cent and consequently increased the normal fuel-air ratio by a like percentage. The engine, therefore, consumed 4 per cent more fuel than was intended, resulting chiefly in a reduction of fuel economy and a decreased operating range.

Another neglected feature of most carburetor air box designs is the introduction of heat to the carburetor inlet for ice prevention. The results of particularly poor design are illustrated by the curves shown in Fig. 9. This air box was used by an airplane manufacturer on a Lycoming six-cylinder engine. The curve shows carburetor fuel flows and carburetor inlet air temperature rise above ambient air temperature versus hot air valve opening in degrees. An examination of these curves shows that this air box caused an initial $2^1/_2$ per cent enrichment in fuel flow with the heater valve in the full cold position and a $7^1/_2$ per cent enrichment with the heater valve in the full hot position. This, again, is lost fuel economy. Furthermore, the heater valve arrangement gave no uniformity of heat control. Up to 30° of heater valve opening no heat whatsoever was added to the mixture. Between 40° and 50° of heater valve opening the majority of the heat was added. This valve, for all practical purposes, became a two-position valve. Full carburetor heat is needed only in extreme emergencies and certainly the condition of either having no heat or full heat is not at all desirable.

Furthermore, this type heater valve is extremely dangerous. The average pilot expects to obtain heat enough to just prevent icing which normally can be obtained by opening the heater valve in small in-

crements. Opening this valve in small increments would produce no heat and the engine could be completely iced up and stop before the pilot knew what happened.

Fig. 10 shows a curve of the same type as Fig. 9 when using the Lycoming design air box. It will be noted that the carburetor fuel flow is not disturbed by use of this air box and that the carburetor entrance air temperature gradient is fairly uniform. The even temperature rise of this air box gives the pilot a much more uniform and much less sensitive control for ice prevention.

Service Ills

Had the engine manufacturer supplied the exhaust manifolding to the airplane manufacturer, all of the service troubles that arose on the particular airplane-engine installation under discussion could have been prevented. Proper design of the junction of the vertical and horizontal exhaust manifold runners at the left front cylinder would have prevented the valve sticking and burning condition. Proper design of the entire exhaust manifold would have prevented the piston scoring, cooling troubles, and erratic engine performance experienced. The cost to the engine manufacturer ran into many thousands of dollars to correct the troubles on this airplane. Most assuredly, the reputation of the engine manufacturer was not enhanced by the troubles experienced, even though the troubles were caused by something other than the engine proper.

General Cooling Problems

The airplane designers of the plane under discussion had done a good job on cooling baffle and cowling arrangement and had achieved a nose section of good appearance. The design of the nose section of most airplanes, from the standpoint of the engine designer, seems to be motivated by a desire to achieve beauty of outline with cooling baffle arrangement being left as an afterthought. A great many engine installations are difficult to cool because of this, and cooling is almost invariably a compromise affair.

The engine manufacturer could also have control over this problem by providing a self-cooled engine to the airplane manufacturer. Fan cooling of a horizontally opposed engine is more difficult than fan cooling of a radial engine but is far from an insurmountable difficulty. First attempts to fan cool a horizontally opposed engine by Lycoming Division resulted in a fan power consumption of about 13 per cent of the engine's power output for adequate cooling. Refinements and new methods of cooling have made it possible to cool an engine of identical displacement, but operating under a much higher i.m.e.p., at a cost of but 6 per cent of the engine's brake horse-

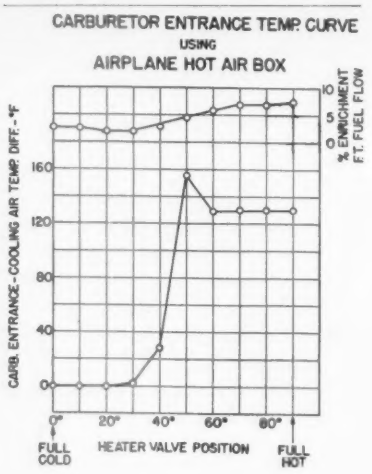

Fig. 9.

power output. Recent tests have indicated that it may be possible to cool this same engine at a cost of as little as 2 or 3 per cent of the engine's power output. Exhaust ejector type cooling also shows great possibilities. Since improper installation usually results in a power loss anyway, the effects of which are detrimental to engine life and economy, it seems logical to use this anticipated power loss for driving a fan and to a distinct advantage rather than a disadvantage.

Accessories

The engine manufacturer would be at a great advantage if he were to supply just the exhaust manifolding, carburetor air box, and fan or exhaust ejector cooling as an integral part of the engine. But, why stop here? Why put drives or mounting pads on the engine for fuel pumps, starters, generators, etc., allowing the selection of accessories to the airplane manufacturer? A failure of any accessory directly affects the reputation of the engine manufacturer in the

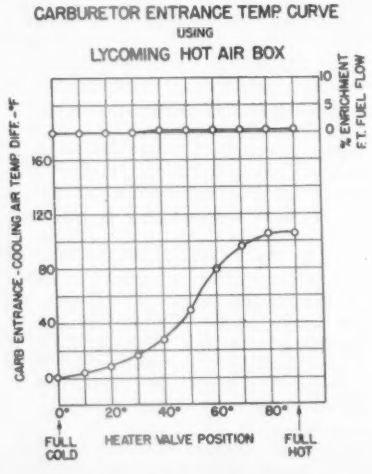

Fig. 10.

eyes of the operator. Why not provide all accessories as an integral part of the engine? Certainly no one believes that the day of hand cranking an engine is not past. With radio reception a necessity for anything but airport flying, certainly no one can deny the fact that a generator is a necessity. No one would purchase an automobile without these conveniences. Why not supply them as an integral part of the engine?

Conclusion

Why not go further than all this and provide a vibration arresting engine mounting, integral air and oil filtering units, integral oil cooler, etc., thus supplying complete "Packaged Power" from fire wall out; a self-starting, self-generating, self-cooling, vibration-free power plant, free of trouble from the standpoint of installation with the added advantage of being free of the usual service ills incident to incorrect installation?

All that might be required of the airplane designer would be the inclusion of a relatively small air inlet to and a relatively small air outlet from the "Packaged Power," both to be located in a minimum pressure area equal to atmospheric pressure. He could fair around the close fitting, integral cowling to his heart's content and could not affect the engine performance one iota.

Certainly when the engine industry supplies this type installation and the airplane industry accepts it, a truly superior aircraft engine will be achieved. The initial cost per unit to the airplane manufacturer might have to be increased, but it will be offset by the reduction in airplane manufacturing costs incident to the engine installation. The installation will be done once, by engine men who surely should know better than any group of people just how to accomplish it properly. The cost of doing the job right, and once only, will benefit all airplane manufacturers using this power plant, saving each individual manufacturer many man-hours installation labor and test work. Furthermore, the correction or improvement of any installation item on the basic power plant will affect not just one aircraft manufacturer, as is now the case, but will benefit all aircraft manufacturers equally. Do the job once on the "Packaged Power" unit and it will be done for all users.

The service costs to the operator will be greatly reduced and the life between overhauls greatly increased. The aircraft industry certainly will not have a desire to build engines when they are receiving superior engines at a cost equal to or less than that for which they can build them.

"Packaged Power" can be supplied. Will the aircraft industry accept it?

The B.F. Goodrich Airliner of the month

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Many B. F. Goodrich products fly with the Constellation. Among them are De-Icers which protect her mighty wings and empennage surfaces, and B. F. Goodrich tires and tubes which lessen the shock when her 40-ton bulk comes to earth.

B. F. Goodrich salutes TWA in naming the Constellation this month's "Airliner of the Month."

In war or peace

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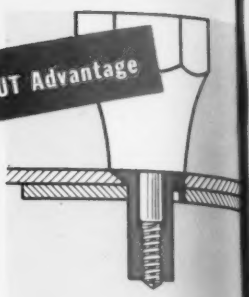
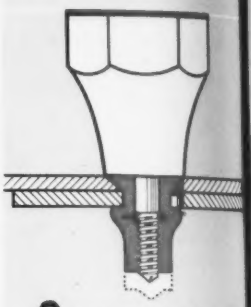
Easy Installation Big RIVNUT Advantage

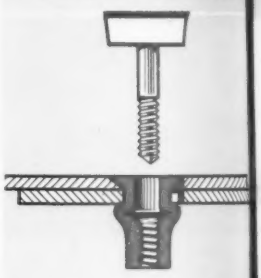


1 Thread Rivnut onto "pull-up" stud until head of Rivnut touches anvil of heading tool.

2 Insert Rivnut into hole. When Rivnut with key is used, be sure the key is indexed to enter the keyway previously cut in metal.



3 With tool at right angle to work, squeeze lever. This retracts "pull-up" stud into tool, which causes counterbored portion to bulge, forming a head against the blind side.



4 Unscrew "pull-up" stud, leaving threads of Rivnut intact and ready for use as a nut plate.

5 Attaching accessory with screw is easy now. Rivnut threads grip screws firmly after upset.

RIVNUT...A SIMPLE BLIND FASTENER!

One-piece can be used as blind rivet, as nut plate for attachment . . . or both!

THE B. F. Goodrich Rivnut is a one-piece tubular aluminum rivet with a counterbored, internally threaded shank. It is headed with a simple hand tool while working entirely from one side. A threaded pull-up stud on the tool engages the threads inside the shank, and when slight pressure is applied, a ring type bulge forms on the blind side. This bulge or upset is large enough to resist being pulled through metal or plastic even under conditions of eccentric load. For nut plate use, Rivnuts are available with key for torsion resistance.

Rivnuts are strong, light in weight, low in cost. They're ready for use "as received" and fit tight without preliminary refrigeration or other preparation. A full range of standard sizes, types, and grips is available; also plug and accessory screws. If your fastening problem requires a special-purpose Rivnut, B. F. Goodrich engineers will be glad to work out details and designs with you.

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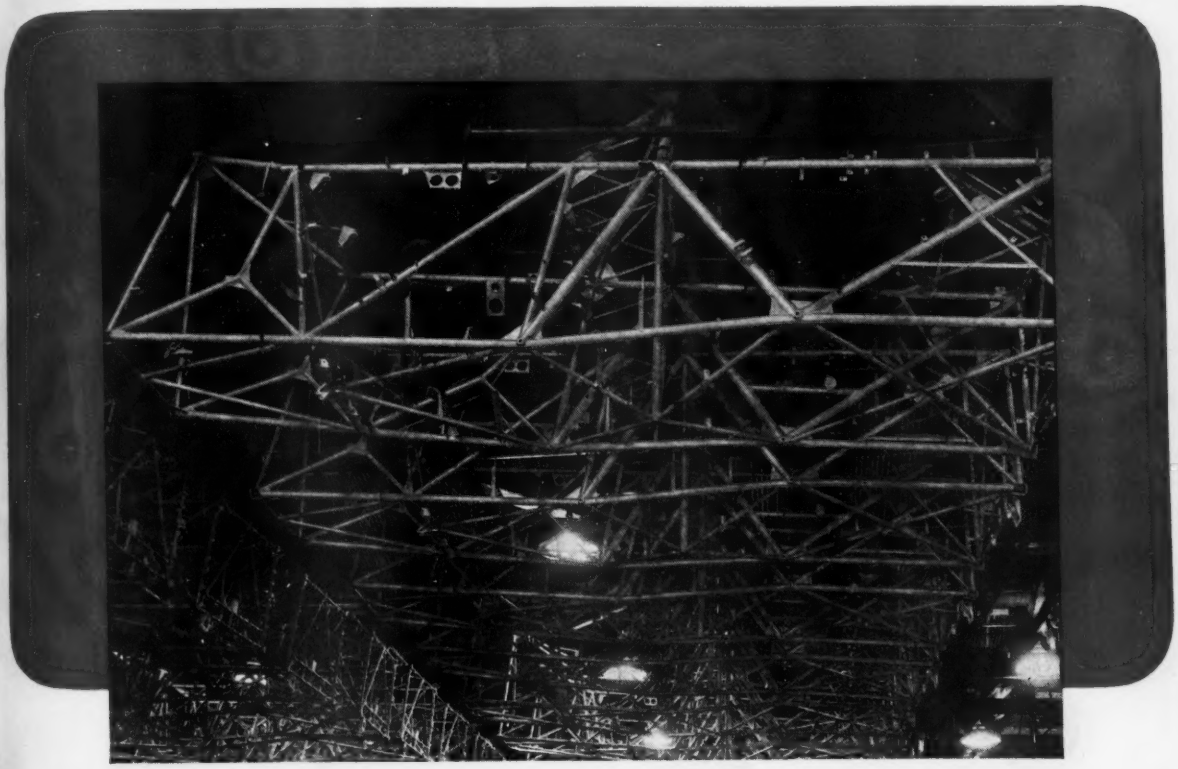

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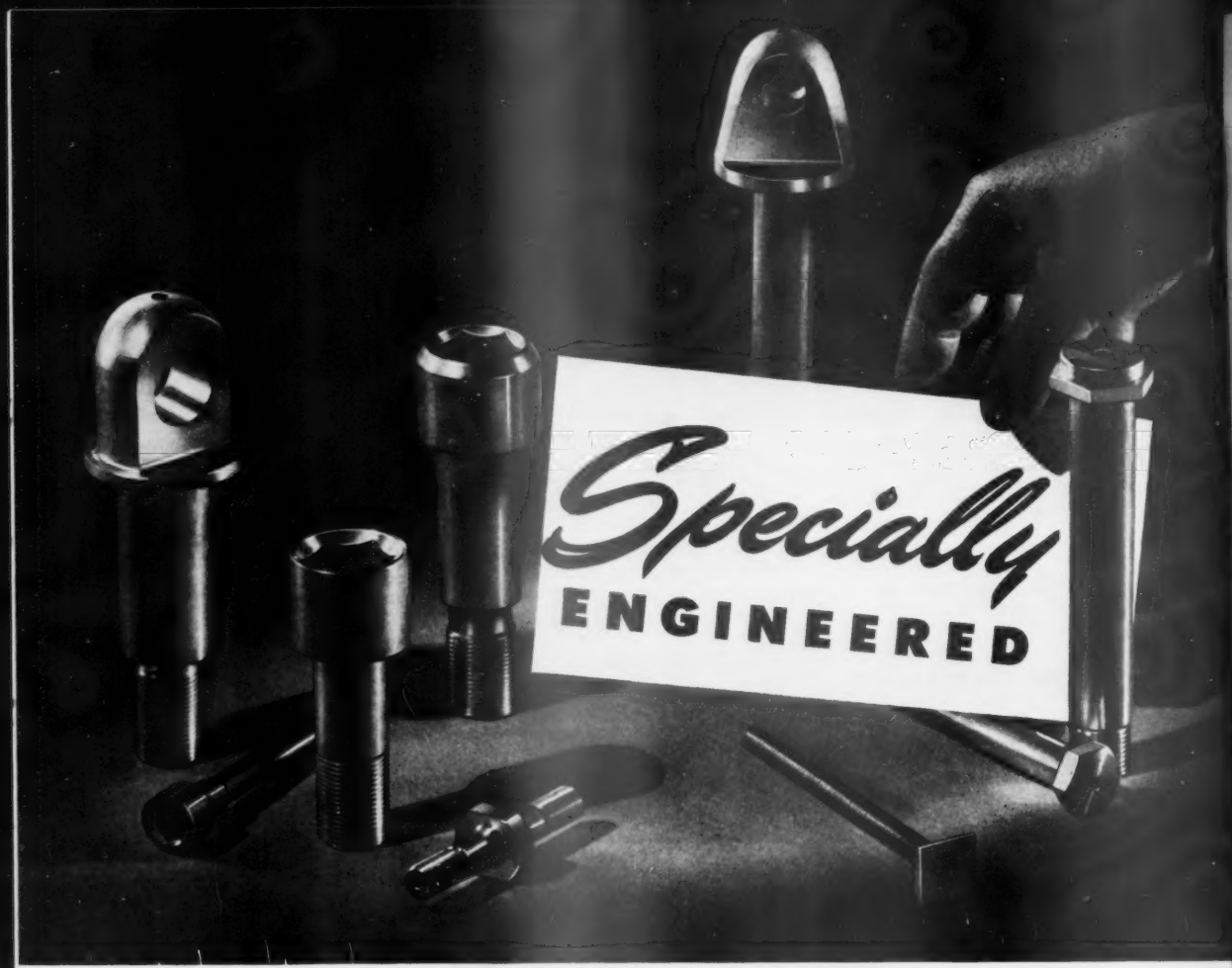
IT MAY HELP THE ENEMY



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Aircraft Hangars and Terminal Buildings of Reinforced Concrete

CHARLES S. WHITNEY*

Synopsis

In this time of rapid development of new materials in the aircraft industry, reinforced concrete should be given consideration because of its adaptability to the long spans that will be needed to house large aircraft. Although it has been in use since the time of the Romans, concrete is still a new material that appeals greatly to the imagination of the designer.

Recent developments in the technique of the design and manufacture of concrete have been so rapid that its possibilities have not yet been fully developed.

Many things have been discovered in the last 10 years about the characteristics of concrete which permit more precise design of structures and more accurate control of the material. Transportation to the forms by pumping and consolidation by high-speed vibrators are examples of improved construction methods. Improvements in cement result in almost doubling the strength of concrete and increasing its reliability.

It is the purpose of this paper to point out what has been accomplished in the past and how concrete can be used in the construction of hangars and accessory space for any terminal facilities that may be needed.

The period immediately after the war will undoubtedly see a tremendous development of commercial airports. It is important that hangars and terminal buildings be substantially built and economically designed so as to result in the lowest possible operating cost to the air lines using them.

This paper describes a newly developed type of long-span reinforced concrete shell construction which should provide the kind of structure needed.

Long Span Construction in Concrete

The basic structural form best suited to extremely long-span aircraft hangars, the reinforced concrete arch, has been highly developed in the construction of bridges in many lands. A number of these have clear spans over 400 ft. in length.

In these cases, the concrete arches supported columns carrying heavy roadways. In the case of long-span hangars, the arch may be used to form the roof itself and is required to carry only the weight of the roof construction in addition to comparatively light wind and snow loads. Much longer spans are

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* Consulting Engineer, Milwaukee, Wis.

perfectly feasible, and it is safe to say that any span that may be desired to house the largest aircraft of the future will be practical in concrete.

The Plougastel bridge completed over 10 years ago has three spans of 590 ft. each. This carries a railroad and highway over an estuary near Brest, France. A study for a concrete span of 1,000 m. has been worked out in sufficient detail by the designer of the Plougastel bridge to prove that it does not present any construction problem that cannot be met by the methods used at Plougastel.

History of Aircraft Hangars in Concrete

The concrete hangar already has an interesting history that starts with the early development of the airplane and airship. Fig. 1 shows concrete hangars built in France in 1916.[1] The roof consists of an arched slab of 151-ft. span stiffened with monolithic ribs placed outside of the slab, leaving a smooth ceiling to simplify the moving of formwork. This method has been used recently.

The construction of a reinforced concrete airship hangar of 307-ft. span was started in France in 1918, but it was discontinued because of the armistice.[2]

The great concrete hangars at Orly in France, started in 1922, have a span of 282 ft. and a height of 181 ft.[1]

A still larger concrete hangar with a span of 413 ft. to house two dirigibles was started at Seville for the Seville-Buenos Aires Airline. Construction was interrupted by the war and it is still incomplete.

An interesting type of reinforced concrete cantilever hangar, built recently in Rio de Janeiro[3] is shown in Fig. 2. The door length is over 400 ft. and the distance from door to columns is about 75 ft. This type might be found suitable for nose hangars.

A New Development in Hangar Design

As a general proposition, the simplest solution of a structural problem is the best. This appears to be true in the case of the problem of providing for the housing of large aircraft together with space for shops, storage, warehousing, and offices. This requires construction of a high roof of long span in connection with buildings of ordinary proportions. A logical solution is the use of light reinforced concrete arches springing between concrete lean-to structures that can be designed to provide any accessory space desired.

Attempting to determine the most direct solution, the writer has developed a new type of reinforced concrete shell construction. Fig. 3 is a three-view photograph of a model of an airplane hangar of 220-ft. clear span with lean-tos on the rear and one side only. The roof is composed of a thin concrete slab, stiffened by integrally cast ribs spaced 20 ft. apart. The slab forms the roof

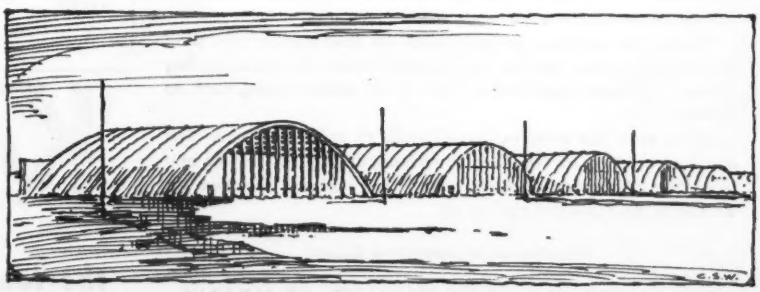
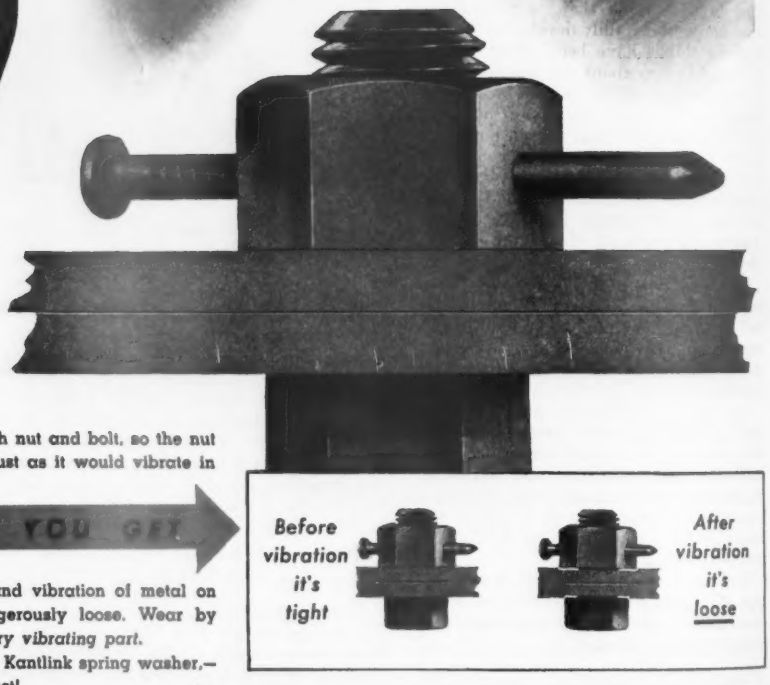


Fig. 1. Reinforced concrete airplane hangars at Istres, France, 1916.

LET'S SPIKE A NUT

. . . to prove a point!



DRIVE A SPIKE right through both nut and bolt, so the nut can't budge. Now vibrate the assembly just as it would vibrate in ordinary use.

HERE'S WHAT YOU GET

—the nut did not move, but the strain and vibration of metal on metal wore the other parts loose—dangerously loose. Wear by abrasion, and *bolt stretch* etc. *loosen every vibrating part.*

Now keep the spike in but add a strong Kantlink spring washer,—then vibrate it just as you did in the first test!

HERE'S WHAT YOU GET NOW

Yes, still tight, because the strong Kantlink spring reaction held it tight. The Kantlink Spring washer expanded exactly as fast (and as far) as the inevitable *wear tended* to loosen the parts.

There is no substitute as economical. No fixed nut nor any short range multi-toothed washer can possibly equal the great holding power of a *wide-range live spring*—a big helical spring such as Kantlink.

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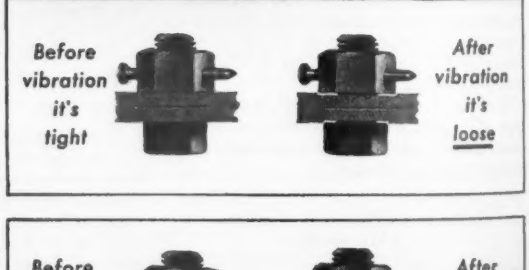

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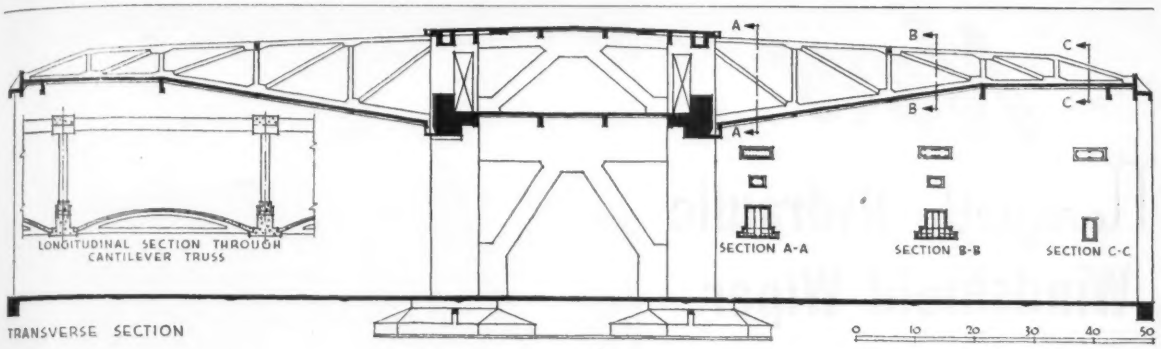

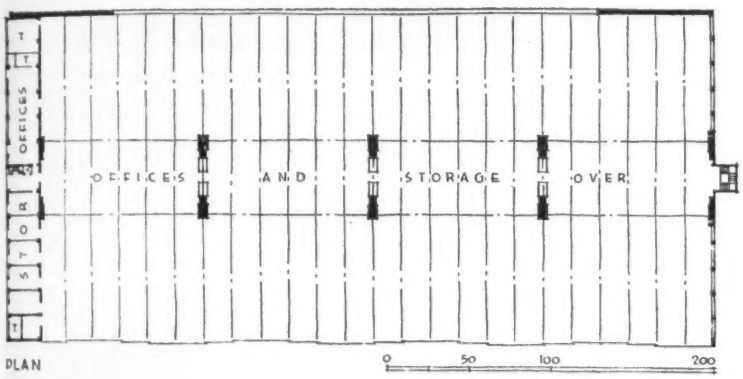

Courtesy of Architectural Record

FIG. 2. Concrete cantilever hangar at Rio de Janeiro. Marcello Roberto, Architect, Fragoso & Ness, Engineers.

and also acts as a structural shell carrying part of the roof load through arch action. The ribs are designed to resist the effects of unevenly distributed snow, wind, and crane loads. The roof must also be designed for the effects of volume changes in the concrete due to shrinkage, temperature changes, and plastic shortening from permanent loading. These effects are relatively more important in the case of a hangar roof than in that of a more heavily loaded bridge arch.

Because of the slenderness of the arches, analysis is also made of the effect of deflections on the rib bending and of the tendency to buckle. If too slender, the ribs would be elastically unstable.

A novel feature of this construction is the placing of the slab about mid-height of the ribs at or near the neutral axis. This has important advantages that result in a considerable reduction in cost.

First, it eliminates the participation of the slab in the bending strains in the ribs. If the slab is at the top or bottom of the rib, it is obvious that bending the rib will induce direct compression or tension stress in the slab. Furthermore, because the slab is curved, this direct stress in the slab causes a cross bending in the slab of serious magnitude. Eliminating this direct stress and bending permits a much more economical design.

Second, by reducing the stiffness of the ribs without reducing their strength, it greatly reduces the thrust and bending in the ribs due to temperature changes, shrinkage, and plastic flow in the concrete. This effects economy in both the ribs and their supporting abutments, reducing the tendency of the ribs to push over the lean-to structures.

The roof should be entirely covered with insulation and roofing to reduce the temperature changes and to prevent leakage. Skylights can be built into the roof to give any desired amount of light. End walls and door guides are supported against wind pressure by means of horizontal trusses suspended from the arches at the height of the door heads.

The Arches

The arches are monolithically fixed at the tops of the side walls. This support is made as rigid as practical, but its elastic displacement is considered in the

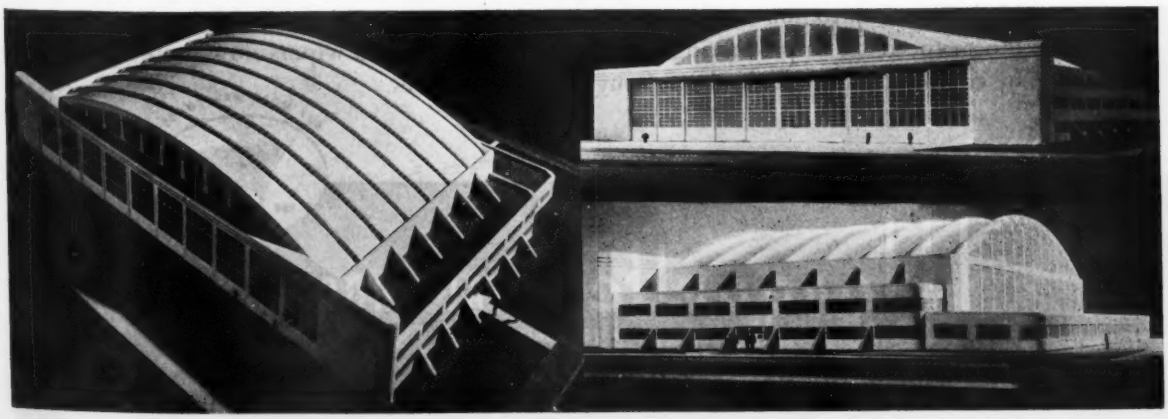

FIG. 3. Model of arched concrete shell hangar.

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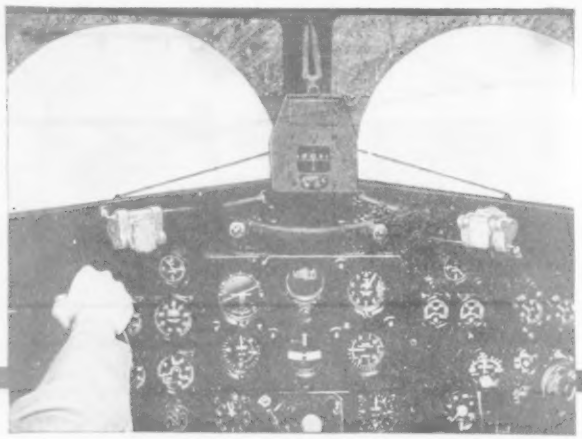

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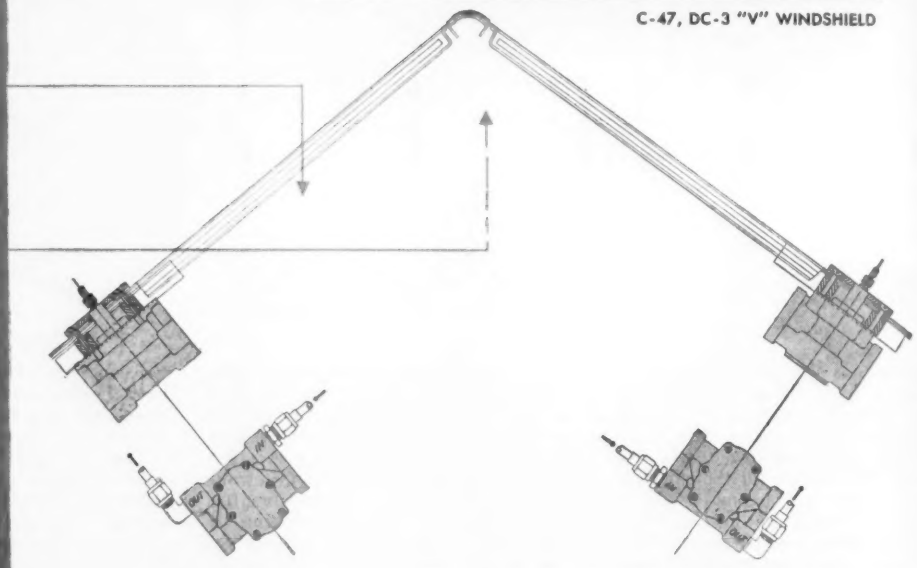

Cockpit installation. Blades not shown.

• A powerful new hydraulic motor makes it possible to offer a greatly simplified and improved Windshield Wiper assembly. Compared to the earlier models, there are important savings in weight, installation time, maintenance and over-all costs. Convenient installations are easily accomplished. The hydraulic motor, though small, has a high torque, permitting a blade speed up to 400 strokes per minute during flight. It is backed by our long experience in pioneering and producing windshield wipers now used by commercial airlines and on Army and Navy planes.

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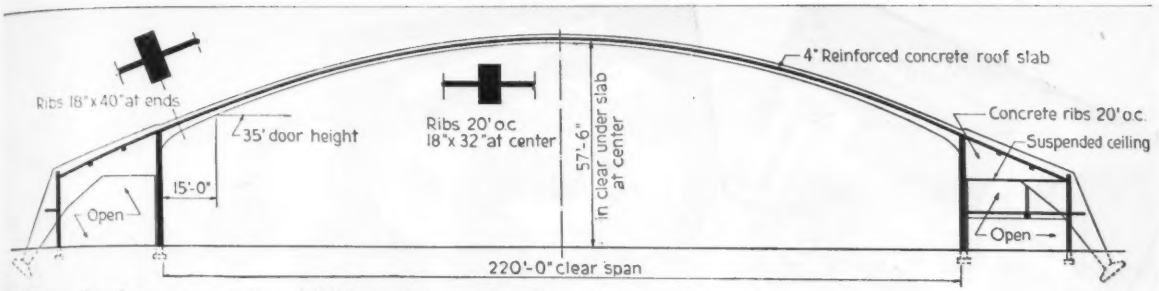

Longitudinal and transverse sections of 220-ft. clear span reinforced concrete hangar.

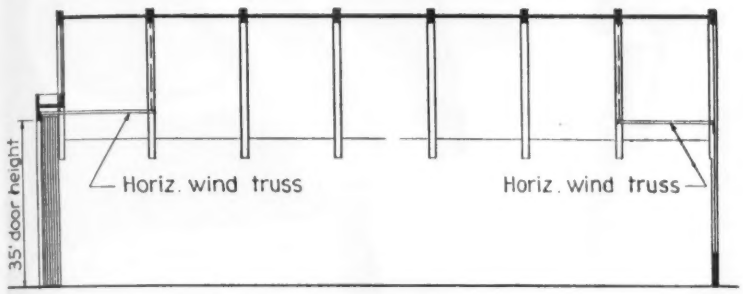

FIG. 4. Sections of 220-ft. clear span concrete hangar.

design of the arches. Usually the ends of the arches can be dropped a few feet below the door head because the full clearance is not needed for a short distance from the wall. The side walls can be made much lower than in the case of steel truss spans because the height required by the trusses is also eliminated. The height of the concrete hangar at the center of the span is about the same as that of the steel hangar, and, although the interior clearances are better in the concrete hangar, the enclosed volume is considerably less, resulting in lower heating cost.

The arch abutment consists of a vertical support at the side wall and an inclined buttress passing through or over the lean-to and thrusting against spread footings. This forms a stable support which is designed, as in the case of bridge abutments, for the extreme position of the thrusts due to all possible loading conditions. The thrusts are, however, much lighter than those from corresponding bridge spans, and the foundation pressures are not excessive for ordinarily good soil. If the foundation conditions are bad, piles may be used with prestressed steel cable ties to take the thrusts that cannot be safely carried on batter piles.

Buttresses

The inclined buttresses form the most economical means of resisting the arch thrusts and lateral wind or earthquake forces. If in special cases it is not practical to provide the space for the buttresses, it is feasible to provide ties of prestressed steel bridge cables at the level of the springing of the arches. The cables can be prestressed by hydraulic jacks so that the dead load of the roof causes minimum distortion of the arches. The tied arches and their supporting columns are then designed as elastic frames. This type of construction is also suitable for multiple spans.

The concrete hangar has a number of advantages, the most obvious of which are fire resistance and low cost of maintenance. It can be made attractive in appearance both inside and out. The inside of the roof should be painted white and flood-lighted to provide a well-diffused light.

The fact that reinforced concrete work can be done in most parts of the world with a large proportion of local labor and material may be important in many cases, especially during the postwar period. This will result in economy as well as the creation of local employment and good will for the owner. The concrete hangar involves no serious difficulties in construction because the required materials are generally available and because there are many contractors who have become proficient in the building of large concrete structures. This is true not only in this country but also in most foreign countries.

AIRPLANE HANGARS

Fig. 4 is a longitudinal and transverse section of an airplane hangar with a clear span of 220 ft. showing the construction that has been described. The roof is a slab 4 in. thick with ribs spaced 20 ft. center to center. The ribs have an average depth of about 3 ft.

Fig. 5 is a study for a 400-ft. span which presents no more difficulty than a much smaller one. A structure of this kind might be suitable for an important air-line terminal, and in such a case the lean-tos could be expanded into large terminal buildings so that all operations would be housed together.

The arched form of hangar appears to be entirely satisfactory from an operations point of view if properly designed. Many of the hangars built within the last few years are already inadequate

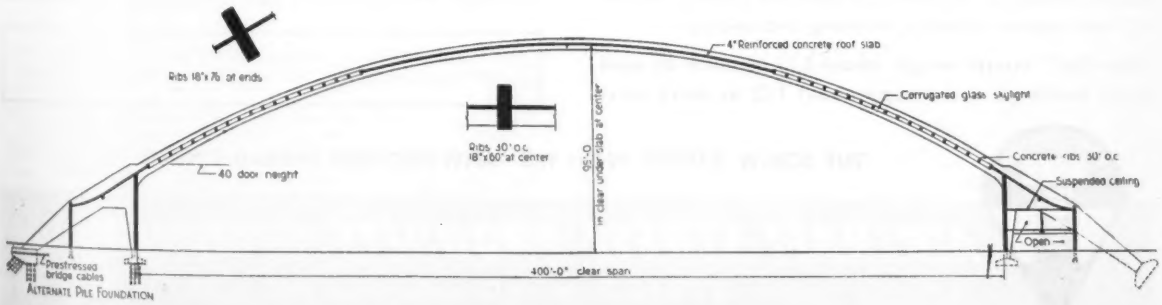

FIG. 5. Section of 400-ft. clear span concrete hangar.

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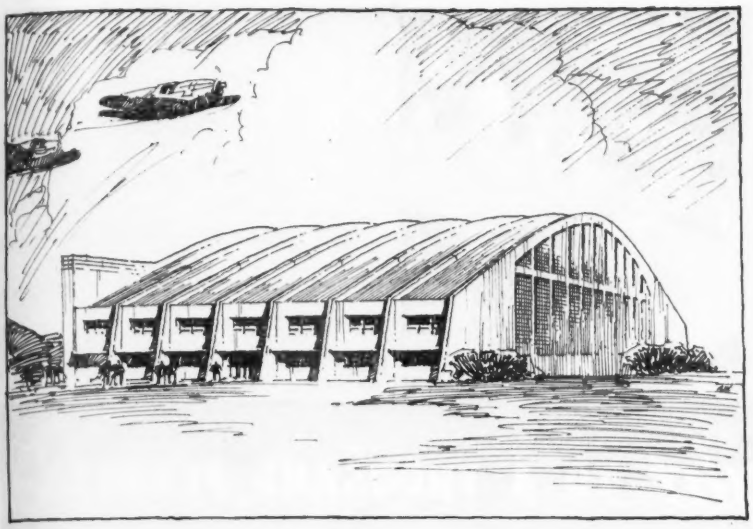

FIG. 6. Sketch of architectural treatment for concrete hangar.

because they were not designed for the type of activities now found necessary. A common fault is insufficient clearance and too little lean-to space. A functional study should be made, as in the case of an industrial plant, so that suitable accommodations will be provided for maintenance and repair operations, storage, offices, commissary, and efficient handling of materials and employees.

Overhead crane runways can be suspended from the roof over the areas where service is desired, but the trend is toward the use of floor hoists in the hangar itself. Sprinkler systems and lighting should be designed so that it can be easily serviced from catwalks or from small cars suspended from light rails running the length of the building just under the roof. These also will provide access to the ceiling for painting.

The lighting should be a combination of direct and indirect. Flood-lighting a white ceiling provides a well-diffused illumination and a light background for the direct units which reduces eyestrain.

Fig. 6 is a perspective study showing a possible architectural treatment of the exterior of a hangar with the lines of the ribs extended down to the ground through the buttresses.

AIRSHIP DOCKS

Reinforced concrete arched shell construction is also suitable for airship hangars. The insulated concrete roof would reduce or eliminate the difficulty that has been experienced from condensation of moisture in steel hangars.

The integral shell construction stiffened with fixed-end arches is more rigid than other types. This is especially important for dirigible hangars because the distortion of the roof under wind load and door thrust is greatly reduced, maintaining the top hinges of the doors in an almost fixed position and eliminating one of the difficulties with orange-peel doors.

Fig. 7 is a cross section of an airship terminal building with a clear span of 260 ft. Considerable economy is effected by springing the roof arches from the top of rigid A-frames about 90 ft. high. These frames are built into lean-tos that can be planned to provide all the space needed in connection with the terminal of a lighter-than-air transport line.

COST OF CONCRETE HANGARS

The first cost of concrete hangars of the type proposed by the writer will, in general, compare favorably with that of steel hangars. It may, in different cases, be greater or less depending on the particular conditions. The relative cost will depend on the cost of labor and of different materials, as well as the design requirements, and on foundation conditions.

The concrete hangars in France, Italy, and Spain were reported to be cheaper than competitive steel designs, and conditions in most foreign countries are favorable to cheaper concrete construction.

It may be assumed that, in general, the lean-to portion of the hangar will be cheaper in reinforced concrete than if built with a structural steel frame. The concrete arched shell is an efficient structural form carrying the loads in the most direct manner to the foundations without the elaborate incidental bracing required by steel frame construction. The side walls are lower and the enclosed volume is less.

The relative cost of the concrete hangar in comparison with steel depends greatly on the type of steel hangar considered. The concrete structure is substantial, highly fire resistant and will require little maintenance. The steel hangar may be of light construction with sheet-metal roof deck and walls of factory type, or it may have a substantial roof deck and masonry walls. It may be expected that the cost of a concrete hangar will ordinarily lie within the range of cost of possible steel construction.

The quantity of concrete and steel in the concrete hangar roof is small and the formwork is simple. The forms must be carried on a high falsework, which, for the 220-ft. span illustrated, will probably cost about $1.00 per sq.ft. more than the falsework for ordinary concrete floors with a 10- to 15-ft. story height. The falsework for a high airship hangar will still be of light construction and would probably cost an additional $1.00 per sq.ft. Concrete placing is not difficult since it can be pumped to the to pof the roof regardless of its height.

In selecting the type of structure it should be kept in mind that the cost of the doors and equipment of the hangar will be large compared to that of the structure itself and that a substantial fireproof construction is justified to protect the entire investment.

The structure must be judged on the basis of annual cost and not first cost. A well-designed and constructed reinforced concrete hangar should have a lower annual cost than any other type because of lower depreciation, maintenance, and insurance rates. The cost of heating and lighting should be low because of smaller enclosed volume and a smooth white ceiling.

(*Continued on page 103*)

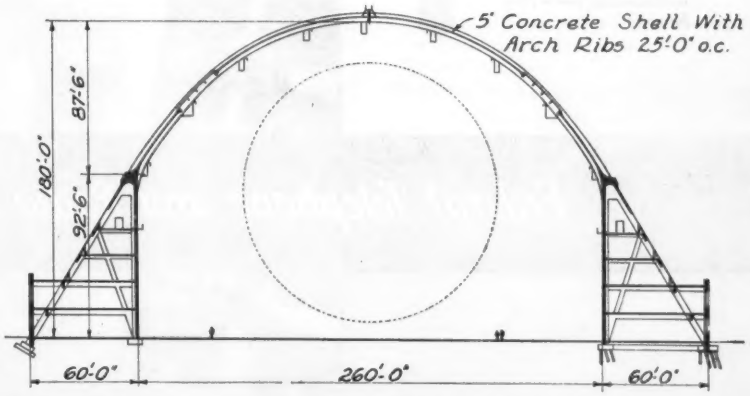

FIG. 7. Cross section of concrete dirigible hangar and terminal building.

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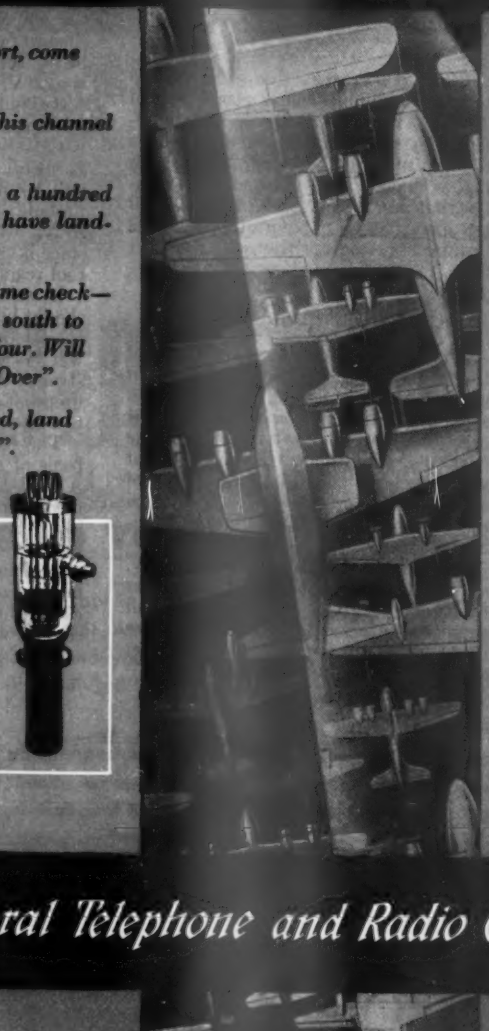
"Airport to Flight 232, this channel open for you. Over".

"Flight 232, we are now a hundred miles due south, can we have landing instructions? Over".

"Airport to Flight 232, time check—now 10:24, land 10:39, south to north runway six, beam four. Will clear 10:38, time check. Over".

"Flight 232, time checked, land 10:39, orders clear. Roger".



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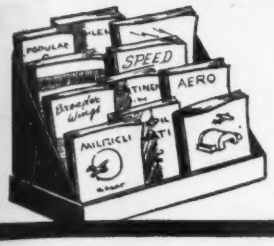

Periodicals

Accessories and Equipment

Vapor Lock—or Dumb Engineering. R. J. S. Pigott. A survey is made of the hydraulic aspects of the vapor-lock problem in fuel systems. Consideration is given to the hydraulic design of the fuel-supply system from the tank to the fuel pump. It is stated that the cause for carburetor vapor lock beyond the fuel pump becomes largely a question of the ability of control orifices of any type to measure mixtures. In general, control orifices can measure only a homogeneous fluid correctly. The general methods of calculating a system for obtaining the limiting tank temperature for take-off and the limiting altitude for any system are discussed, and the requirements are summarized. *SAE Journal*, July, 1944, pages 310–317 (Transactions), 12 illus.

Electrically-Driven Gyros. Accompanied by photographs, some brief data are given on electrically driven gyroscopes manufactured by General Electric for aircraft instruments. The four types noted are used in a horizon indicator, direction indicator, horizon control, and directional control. The electrically driven units are credited with offering several advantages over air-driven types of gyroscopes in that they are able to maintain constant performance under extreme conditions of altitude and temperature. *Aero Digest*, July 15, 1944, page 104, 5 illus.

Leaning the Fuel Flow Without Regrets. Frederick H. Smith. The purpose and operation of an instrument for indicating the conditions inside an engine combustion chamber at any given time are explained. Called a "detonation detector" at present, the device provides the pilot with a means of determining just how much power he can safely draw from his engines. It is also used in testing routines for discovering engine faults before the power plant reaches the failure point. By permitting the fuel mixture to be leaned with full knowledge of what is happening inside the combustion chamber, it is suggested that the detonation detector will lead to about a 10 per cent reduction in gasoline consumption. Graphic representations of actual flight-test results from operation of the device in the Lockheed Hudson are offered. *Air Transport*, July, 1944, pages 34–37, 4 illus.

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Engineering Review or the Institute of the Aeronautical Sciences.

Aircraft Actuators. H. E. Schrader. The functions, construction, and operation of several types of aircraft actuators manufactured by Western Gear Works are described. Among the actuators particularized are: No. El-1095, a torque-shaft type actuator containing an electric motor within its housing, which is used to operate the wing flaps on the B-17; No E-1127, a torque-shaft type integral with cable and drum, driven by planetary gears, and hydraulically powered, used for bomb bay doors of the B-17; actuators, using a General Electric motor drive through a linkage, which operate the oil-cooler flaps of the P-38; and a jack-screw unit for operating cowl flaps, intercooler flap doors, oil-cooler flaps, and similar devices. *Western Flying*, July, 1944, pages 76, 78, 3 illus.

So You're Going to Pressurize? Charles W. Morris. A study is made of the requirements for pressurizing the cabins of transport aircraft to provide passengers and crew with adequate air at proper temperature and humidity during flight. Basic air-input allowances for respiration and ventilation are estimated with a safety factor of 100 per cent, and a cabin-blower capacity is established at $^2/_3$ lb. of air per passenger per min. This air mass is based on an air density equivalent to that at 5,000 ft. under standard air conditions or that which would prevail at 2,000 ft. altitude at an air temperature of 80°F. in the cabin. In an airplane that normally carries 40 passengers and a crew of four or five, it is found desirable to furnish a maximum airflow of approximately 30 lbs. per min. at a density of 0.066 lb. per cu.ft. Methods are outlined for meeting conditions arising from higher temperatures in tropical areas, such as the provision of fans for recirculation of air.

For high-altitude flight, means of raising the air pressure in the cabin are considered, figures being deduced for the required inflow of air at various levels by means of superchargers, blowers, or other devices. Leakage is one of the important problems to be solved; it amounts to between

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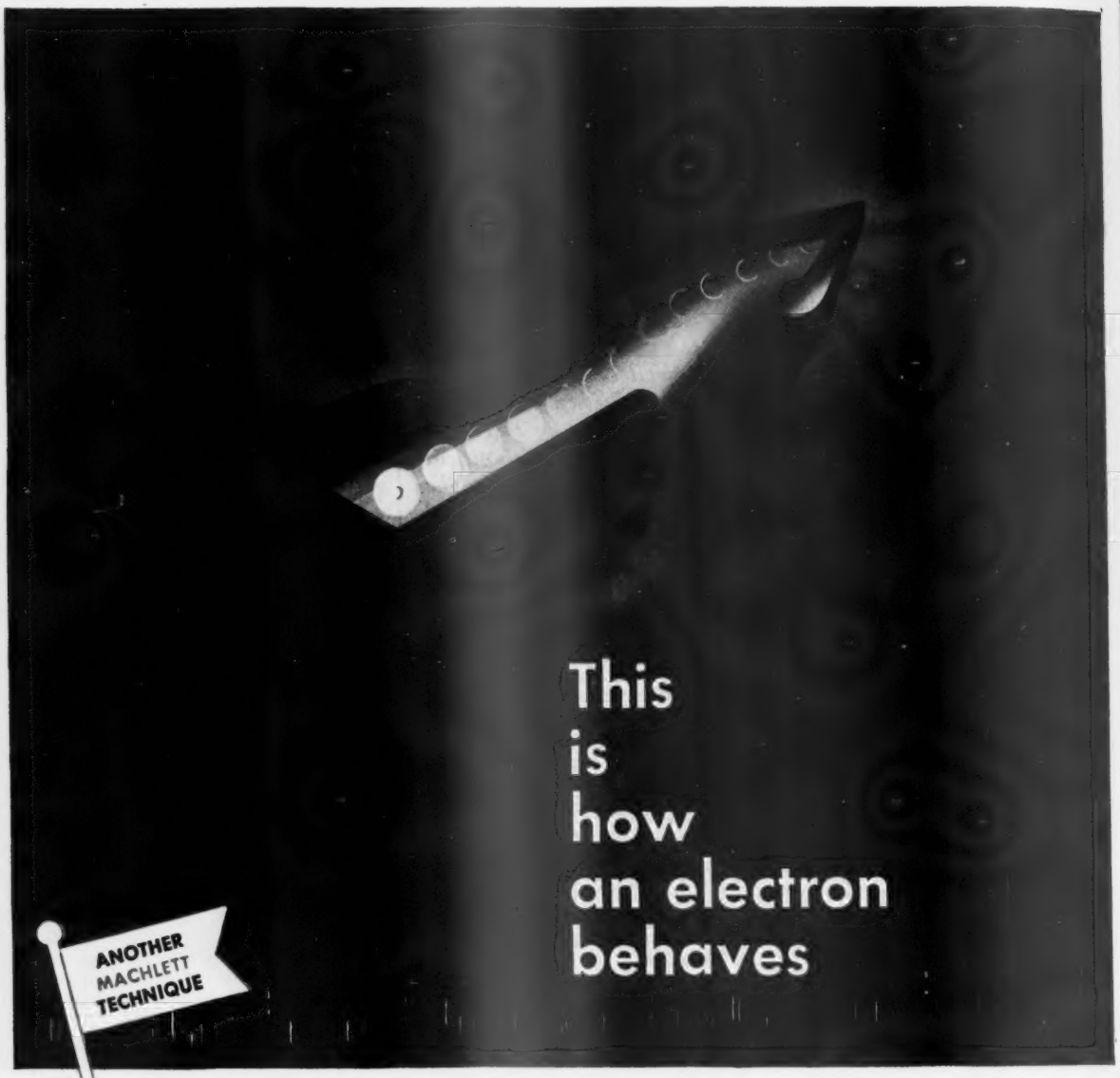
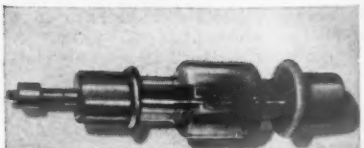


In designing a new electronic tube, mathematical calculations are invaluable, but as every designer knows, they are but preliminaries. After them, there usually come many tests of various experimental tubes. Machlett thought the cut-and-try method not only wasteful, but not productive of the best results. So we shortened and simplified the procedure by what our laboratory people call the "rubber model."

Here is a stretched rubber sheet. At the high end is a model of the cathode (electron emitter) of a proposed tube, and at the other end the anode, or target of an X-ray tube, plate of an oscillator or rectifier. The slope between the two is proportional to the desired potential difference. By means of an electro-magnet, a steel ball can be held in any position along the cathode, then released to roll under gravity to the anode, where the point it strikes can be observed and measured. *This is an electro-mechanical analogy.*

By means of this rubber model technique, months have been shortened into days, weeks into hours. More than that, new and higher performance has been achieved in the final product, so that when you buy a Machlett tube, you are assured of precise results, longer life, greater economy . . . Machlett Laboratories, Inc., Springdale, Connecticut.



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6 and 7 lbs. per min. when the airplane is new and tends to increase with its age. It is suggested that careful attention be paid to leakage as a part of required aircraft maintenance and periodic overhaul. Charts show the variations in pressure and temperature with altitude and variations in cabin air supply and leakage. In conclusion it is suggested that engineers keep in mind the requirements of ventilation and pressurization when designing commercial air transports of the future. *Aviation*, July, 1944, pages 155, 156, 261, 262, 9 illus.

Whitley Glider Towing. Details are given about the towing yoke that is affixed to the rear of the fuselage when an Armstrong-Whitworth Whitley bomber is modified for service as a glider tug. The equipment consists of a movable metal yoke that encircles the rear turret and is limited in movement by steel dogs on the left side only. The yoke is hinged in two bearings held in strong points on each side of the fuselage on a level with the bottom of the turret. A hand lever, fitted to the cross-shaft, moves the yoke into the correct position for locking with a detachable strut. This strut is fitted to the floor and housed in an adjacent longeron when not in use. During flight the yoke is allowed to float so as to prevent unnecessary strain on the fuselage attachments, but it is restrained from excessive motion by suitably tensioned rubber cords stretched between the lever on the cross-shaft and the top of the fuselage. *The Aeroplane*, June 9, 1944, page 647, 1 illus.

Aerodynamics

The Matériel Command's Approach to the Flutter Problem. L. S. Wasserman. It is stated that both experience and theoretical considerations show that the flutter problem increases in importance as the performance of airplanes increases. The method of conducting a flutter survey of new airplane models is outlined. Reference is made to problems connected with the analyses of vibration and to the modern flutter theory. A description is given of studies of vibration modes which were carried out. It was found that the flutter theory and experimental data checked fairly closely. Other sections of the article discuss full-scale flight testing and its difficulties, testing technique, flutter prevention, and the maintenance problem. *Mechanical Engineering*, August, 1944, pages 511–514, 1 illus.

Untersuchung einiger mit den Zylinderfunktionen nullter Ordnung verwandter Funktionen (Investigation of Some Functions Which are Related to Cylinder Functions of the Zero Order). L. Schwarz. In treatises on the two-dimensional problem of a vibrating wing in a compressible medium, there appear four functions of two variables λ and x. These functions are related to the cylinder functions of the zero order. For these four functions the relations $J_e(\lambda, x)$, $J_s(\lambda, x)$, or $N_c(\lambda, x)$, $N_s(\lambda, x)$ are introduced in this report. In order to facilitate interpolation, numerical values for auxiliary functions are given. A more nearly exact theoretical investigation of the functions furnishes numerous relations, among which are potential series, asymptotic representation, cyclic relations, differential formulas, etc. Known special cases are given and relations to functions that have been further introduced are shown. *Luftfahrtforschung*, February 8, 1944, pages 341–372, 6 illus.

Air Cargo

Air Cargo to Bring a Packaging Revolution. Lyle C. Ray. Modern methods of packing air freight and express for shipment are described. It is stated that wartime experience points to many new techniques that may be used in the postwar period. The development of plastics for protective coatings is described. Other forms of protective covering are also discussed. *Air Transportation*, June, 1944, pages 41–44, 2 illus.

Air Power

Air Power . . . Battle-Tested. Major Gen. Paul B. Malone. Disputing Douhet's, Mitchell's, and Seversky's theories with regard to air power, the writer claims that propaganda and biased judgments have created a false impression in the mind of the public as to what can be accomplished by the use of air power alone. It is his opinion that infantry is the dominant instrument of war and that American air power has been developed with recognition of that fact as fundamental. *Skyways*, August, 1944, pages 24, 25, 66, 70, 6 illus.

Nippon Teikoku Kugan (The Imperial Japanese Air Force). Part II. George Stromme. The conclusion of a two-part article evaluating the organization, personnel, equipment, and methods of the Japanese air force. In this installment, Japanese fighter tactics, air-combat patterns, and ground-strafing methods are analyzed. Information is given about Japanese air force decorations and awards, the caliber of their pilots, their methods and procedures of airplane construction, their organization and rate of aircraft production, and the averages of their plane losses. Data are included also on the various models of Japanese bomber, fighter, and transport aircraft, as well as on their engine design and accessory equipment. The writer's conclusion is that if the Allies can vanquish the Luftwaffe they need have no uneasiness about the Japanese air force. *Western Flying*, July, 1944, pages 50, 51, 94, 97, 98, 100, 102, 1 illus.

Strategic and Tactical Bombing (Prepared in cooperation with the United States Army Air Forces). A brief analysis is given of the bombing patterns being used by the Allies against Germany. The difference between tactical and strategic employment of the Allied air forces is indicated, scatter bombing is differentiated from saturation bombing, and mention is made of new weapons that have played a major part in the progress of the bombing patterns. *Skyways*, August, 1944, pages 30–43, 76, 42 illus.

Air Transport

Postwar Problems for Polar Pilots. Wing Comdr. J. C. Goodenough. The writer discusses several problems relative to passenger comfort and aircraft equipment which he claims will have to be solved if air-line operations in Arctic zones are to become feasible. His comments pertain to air-line bases in the Arctic regions; the provision of heated walkways for passengers at these bases; grip tires; hydraulic fluids; special aircraft lubricants; and the decrease of pay load through the carrying of emergency equipment for passenger protection. It is the writer's suggestion that the use of different planes from one stop to another along the northern routes may reduce the overall operating costs. Under this system, planes carrying the special equipment necessary for flight under subzero weather conditions would not be used for the temperate-zone part of the flight but only along the portions of the route where the special equipment was required. *Air Transport*, July, 1944, pages 31–33, 3 illus.

Consairway—An Airman's Airline. Scholer Bangs. The policies and operating methods of the Consairway Division of Consolidated Aircraft Corporation are described. Stressing the air-line's policy of delegating the responsibility of flight operations to the flight crews, it also outlines the history of this California-to-Australia air transport service. In noting the operating procedures, information is given about Consairway's dispatching technique, system of obtaining weather information, use of radio, methods of cargo stowage, etc. *Air Transport*, July, 1944, pages 20–25, 11 illus.

Airline Flying for Postwar Military Pilots. F. A. Spencer. An analysis of the job prospects for military pilots in postwar air-line flying. Besides describing the life, working conditions, and compensations of an air-line pilot, the writer indicates difficulties in the adjustment of military pilots to commercial flying. He also discusses the probable number of military pilots that may be absorbed by

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DESIGN CHECK CHART FOR ECLIPSE TYPE 581, MODELS 12 AND 13 SUPERCHARGER REGULATORS

APPLICATION:

V Eclipse Type 581 Supercharger Regulators, Model 12 for updraft carburetors and Model 13 for downdraft carburetors, are designed to operate independently of the carburetor throttle, automatically controlling the auxiliary stage of a two-stage engine supercharger system to produce constant carburetor air inlet pressure.

V Control of War Emergency Power is also incorporated in these models.

PERFORMANCE:

V The carburetor inlet air pressure in a typical application is automatically held constant, at any altitude within the rated limits of the engine, by throttling the inlet to the auxiliary stage.

V The sensitive element, consisting of the air pressure and the evacuated bellows, measures the carburetor inlet air pressure and functions continuously to prevent that pressure from dropping or exceeding the setting. The auxiliary stage inlet throttling valve is adjusted by an oil actuated servo piston, regulated by a valve connected to the sensitive element.

V War Emergency Power is provided by a bellows which resets the Supercharger Regulator, during water injection, to a higher value. The regulator is automatically reset to normal when the supply of water is exhausted or when water injection is discontinued.

DESIGN FEATURES:

V Compact and light weight, weighs only 4.75 lbs.; regulators mount on engine accessory drive section.

V Low vulnerability and ease of installation provided by internal oil pressure and oil drain passages.

V Oil seals prevent leakage at servo piston shaft.

V Bellows assembly is submerged in oil, preventing damage from vibration and lubricating all operating mechanisms.

V Evacuated bellows provides constant pressure control regardless of atmospheric pressure or temperature variation.

V Compact, lightweight bellows assembly reduces acceleration loads.

V Balanced, oil control valve design provides accurate regulation regardless of oil pressure variations.

V All settings adjustable . . . covered and tie-wired to discourage tampering.

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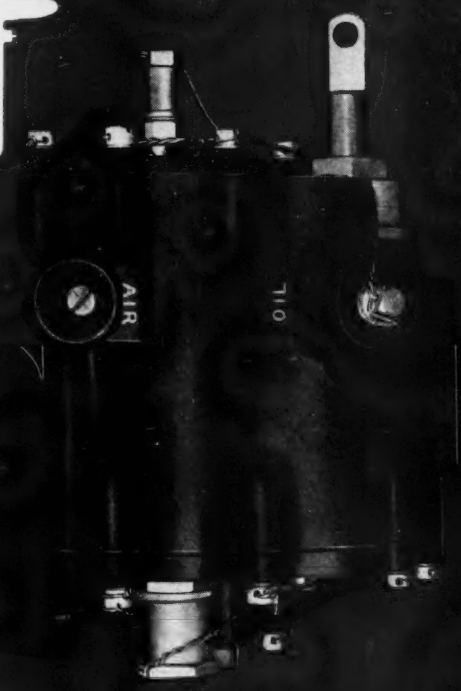

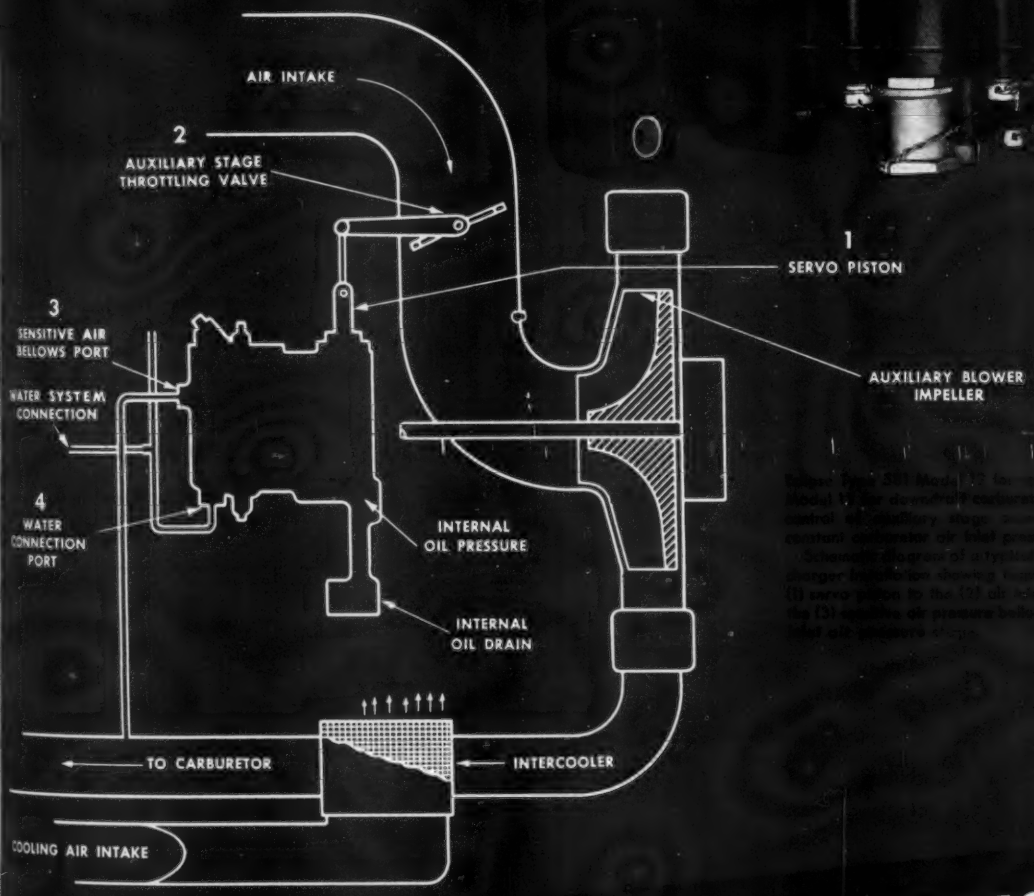

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warning...

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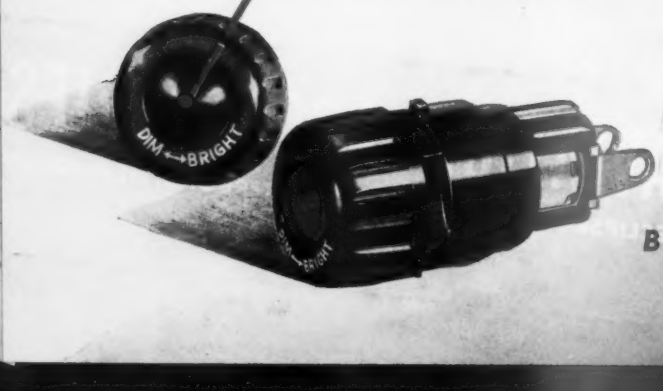

This lamp is completely sealed, resulting in complete confinement of light. Light is visible only at point intended. Equipped with a curtain opening and closing ring. When ring is in closed position (during night operations or where light may be installed in dark or recessed places) light is visible through small opening in center of lens. For daylight operation, curtain is opened to full position.

Specify SA-3821-B; Army Air Forces dwg. 4283592
Weight 7/10 ounce; overall length 2¼", diameter ⅞"

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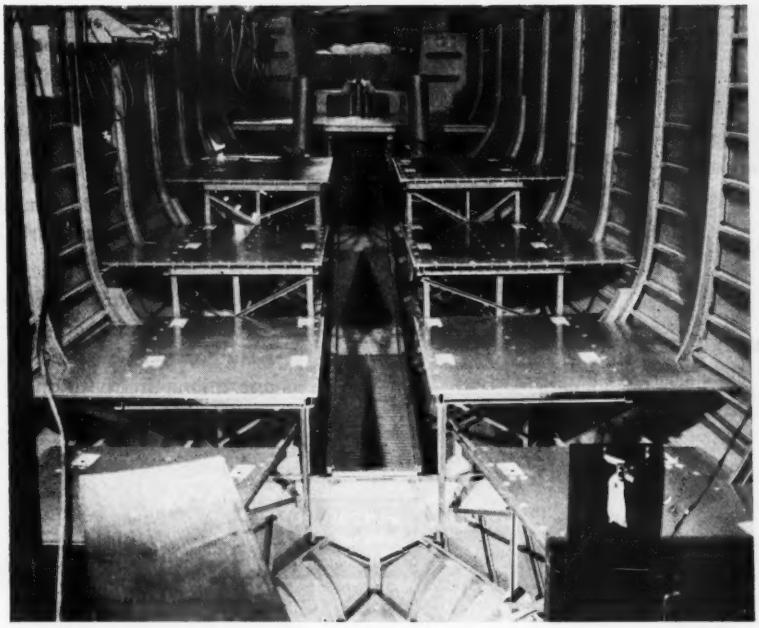
the air lines when peace comes. With an estimate that there will be room for the gradual assimilation of 10,000 pilots, his conclusion is that prospects of air-line pilot positions for military fliers are not so bright as supposed. *Air Facts*, August, 1944, pages 15–28.

Bombers to Transports. Ewart Young. An article about the major modifications made by the British Overseas Airways Corporation to convert Liberator bombers to passenger transports for Return Ferry Service. Structural alterations, removal of units, installation of equipment, rearrangement of components, etc., are described. *Canadian Aviation*, July, 1944, pages 87, 88, 90, 92, 94, 15 illus.

'Air Cargomen Need Surface Know-How.' E. J. Foley. It is noted that three factors dominate the present air-cargo picture: the design of cargo aircraft, the development of devices for handling and unloading, and exhaustive market research to estimate the potential volume. The writer states that unnecessary complications will accompany any conception of air cargo as a virgin field to be cultivated by a chosen few. Extravagant delays of warranted development will follow inattention to the simple common-sense principles and techniques of common-carrier freight transport. *American Aviation*, July 1, 1944, page 70, 1 illus.

Transportation Costs Provide Key to Goods in Air-Borne Traffic. A. W. French. The postwar potentialities of the export trade are considered. It is stated that the questions of what commodities will be carried over international trade routes and how they will be carried can only be answered by analyzing the factors of transportation costs. An outline is given of how weight reduction through light packaging affects the freight-rate structure. *Air Transportation*, June, 1944, pages 26–28, 1 illus.

Weight Savings in Air Transportation. Charles Froesch. In a discussion of the value of weight-saving in airplane design it is stated that for maximum return on a given capital investment transport airplanes must embody characteristics of lightness, excellent aerodynamic qualities, and maximum power. Theoretically, the value of a pound saved is the revenue it can produce if sold on every trip and over the normal useful life of the airplane to which the saving applies. Actually its worth must be based on the fact that a pound saved must be sold and bring revenue to warrant the cost of saving it. Therefore, it may be stated that in a general way the value of a pound depends to a certain degree on the load factor of operation. The effect of range on load factor is discussed. Other problems connected with weight-saving are the compromises that can be made in matters of production, maintenance, structural strength, and aerodynamic characteristics to achieve an economically practical degree of weight-saving. *Weight Engineering*, Summer, 1944, pages 7, 8, 1 illus.



In converting the Consolidated Vultee Coronado, the tail space can be used for either passengers or cargo. The removable passenger seats are fastened to the light metal platforms.

Air Mail Comes of Age. Charles I. Stanton. Some comments with regard to the subsidization of air mail. Offering statistics in proof of his contention that U.S. air mail has reached a point where it can be self-sustaining for the most part, the writer advocates a policy of gradually withdrawing Governmental subsidies from air-mail transportation. His suggestion is qualified, however, by the proposal that exceptions to the "no subsidies" rule be made where necessary. The promotion of foreign air-mail service is indicated as one of the most likely exceptions. *Flying*, August, 1944, pages 24, 25, 150, 152, 3 illus.

Britain's Overseas Air Services. Edward C. Bowyer. One of a series of articles in which the writer offers his views on the postwar potentialities of Empire aviation. His observations were made after a tour of Transport Command and British Overseas Airways routes. In this installment he indicates the Transport Command and British Overseas Airways routes as a basis for extensive postwar air services. Possibilities and plans for postwar air transport in India, Egypt and the Middle East, and Canada are assessed, while the potentialities of private flying are also mentioned. Information is given about the existing air-transport facilities in the regions studied, and the probable market is estimated, with figures for the cost of equipment needed.

It is stated that the writer's chief impression was the general insistence on the part of those interviewed on the need for practical aircraft and the requirement for early development of suitable medium and small transport aircraft in Great Britain. *Flight*, June 1, 1944, pages 589–592, 6 illus.

Britain's Overseas Air Services. Edward C. Bowyer. Based on a tour of Transport Command and British Overseas Airway service routes, the writer expresses his views regarding the potentialities of Britain's air-transport business after the war. In this article he discusses features of structure and design which will have to be incorporated into postwar aircraft if they are to withstand the climatic effects of world-wide travel. Materials that resist the deteriorating effects of weather extremes, the necessity for avoiding apertures in the structure, problems of ventilation, and the need for pressure cabins are among the factors considered. The writer also defends British manufacturers against an existing impression that they are less ready than Americans to design for regional climatic and operational conditions. *Flight*, June 8, 1944, pages 606–609, 5 illus.

Britain's Overseas Air Services. Edward C. Bowyer. This is the concluding article of a series in which the writer reports his impressions of the requirements and trends of British postwar air transport, gathered during a 26,000-mile tour of Transport Command and B.O.A.C. overseas routes. This installment contains his recommendations for improvements that might be incorporated into the design of future British transports. Among these, he points out the desirability of planning every main component of an airplane as a unit that can be quickly removed, changed, and installed for purposes of maintenance and repair. He discusses also the design of the passenger quarters and a "social center," consisting of a dining room, bar, game room, etc.

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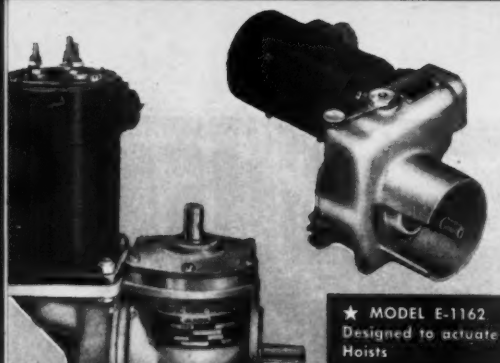

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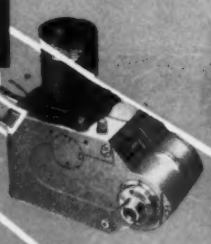

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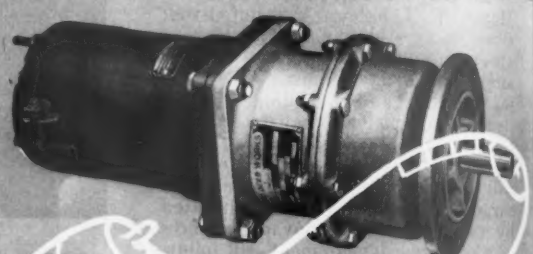

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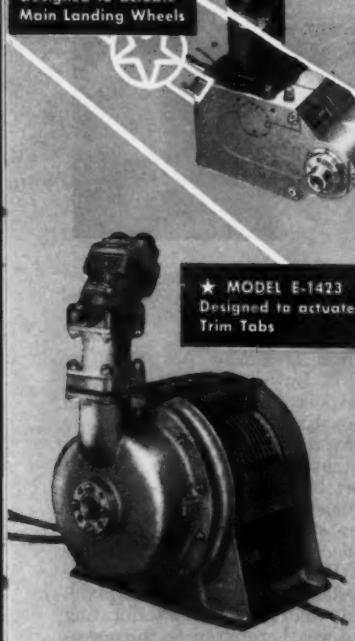

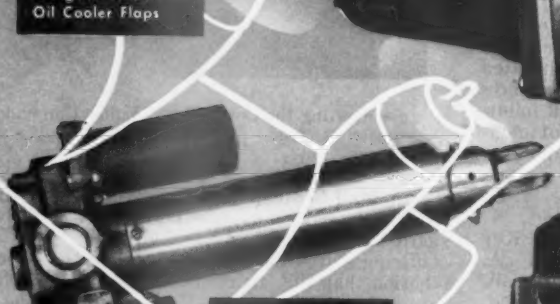

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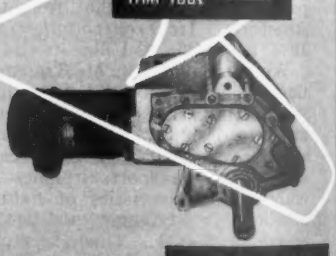

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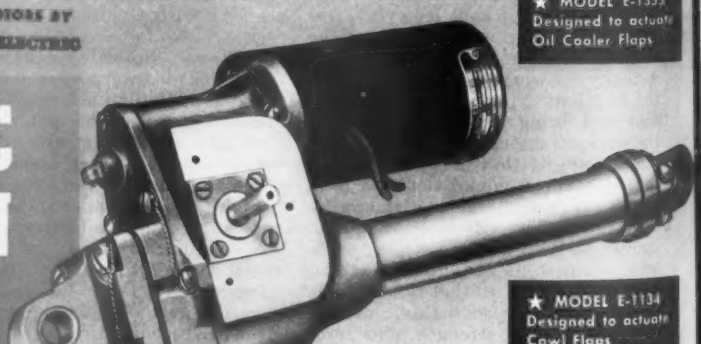

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A few Pacific-Western Actuator models are illustrated. These, and many other designs, are available in various capacities. Each actuator comprises high efficiency gearing with multiple reduction, electric or hydraulic motor unit, plus suitable limit switches and other Pacific-Western features; all especially designed for the particular operation to be performed.

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The writer suggests methods by which temporary transport aircraft can be made available to the British in the period immediately following the armistice while new civil airplane types are being manufactured. Praising the operational record of Transport Command and British Airways, he favorably compares British transport services and aircraft with those of the American Air Transport Command. Other comments pertain to the question of food served on aircraft; load separation of passenger, freight, and mail over the main air routes; landplanes versus flying boats; runways; and public relations. *Flight*, June 15, 1944, pages 643–646, 2 illus.

Your Baggage, Sir. Nils Hansell. This is an article on the Air Transport Command's Transient Service School, located at Camp Luna, N.M. Indicating why such a service was needed, it reports the training of A.T.C. personnel in catering to the needs of travelers—arranging for billeting, ground transportation, laundry, language interpreters, etc. It also notes the value to postwar commercial air transport operations of personnel trained in this type of passenger service. A plan showing the layout of a typical transient service room is included in the article. *Air Transport*, July, 1944, pages 50, 53, 2 illus.

The Case for the Railways. J. Elliot. With emphasis placed upon the value of coordinating all methods of transportation, evidence is offered in favor of permitting railway companies to operate air services within the United Kingdom and between Great Britain and the European continent. Cases where railway companies have operated steamship, air, and bus routes in conjunction with their own rail services are reviewed; plans of the railroad companies for the postwar coordination of rail and air services are outlined; and contributions of resources and experience which the railways can make to commercial flying are noted. *Flight*, June 22, 1944, pages 671, 672.

Aviation's Resources Must Be Sold to Bring Industry an Increase in Business. W. A. Anderson. The writer discusses what the airplane has to offer that will attract profitable business. It is stated that speed, economy, convenience, and comfort are important values related to travel and commerce. More shippers will use airplanes when it can be demonstrated to them that there is an advantage over competitors in speed and economy figured in terms of factory-to-store, rather than in terms of take-off to landing field. *Air Transportation*, June, 1944, pages 38, 39.

Airplane Descriptions

Martin Submits Preliminary Data on 30-Place Short-Range Plane. Merlin Mickel. Some information is given about a 30-passenger, twin-engined, short-range transport plane, designated as model 202, the preliminary plans for which have been submitted to A.T.A.'s Aircraft Requirements Committee by The Glenn L. Martin Company. The plane is designed to meet Air Transport Association specifications for a postwar cargo and passenger short-haul aircraft. Several versions, both high and low wing, with varying passenger and cargo arrangements, are described. Specifications are tabulated and an estimate is given of the operating costs. *Aviation News*, August 7, 1944, pages 43, 44, 2 illus.

The irregularity of receipt of publications from abroad necessitates the review of articles in issues several months late. This is done to provide readers with information regarding foreign technical progress as soon as the issues are available in the United States.

Land-Transportflugzeug Me 323 Gigant (The Me 323 Giant Transport Plane). The Messerschmitt 6-engined army transport is described in considerable detail. It is a semicantilever monoplane of composite construction and has a fixed landing gear. The fuselage is a fabric-covered, tubular steel framework. The enclosed and fully armored pilot's cabin is arranged above the fuselage, in front of the lattice girder of the wing. A sliding roof is provided over the cabin in the rear of the pilot's cabin and serves as an emergency exit. A ladder on the left inner wall of the fuselage gives access to the pilot's cabin and to the other cabins in the wings.

The wings are tapered with square tips. The wing unit consists of three parts: a continuous center section on which the landing flaps are mounted, and two outer wing sections that carry ailerons. The spar is formed by a steel-tube framework. The nose of the wing is plywood covered, as is its entire center section, while the outer wings are covered with fabric. There are four anchoring eyes on each side of the outer wings. The elevator unit and the vertical tail surfaces are of wood construction. The stabilizing surfaces are plywood covered and braced against one another as well as against the fuselage. The landing gear has ten wheels and is faired. It is designed to roll over obstacles in a manner similar to a caterpillar drive, making it possible to land the airplane with a full load on any airfield or on unprepared ground. The six rear wheels are braked by means of compressed air. The take-off run is 800 m.

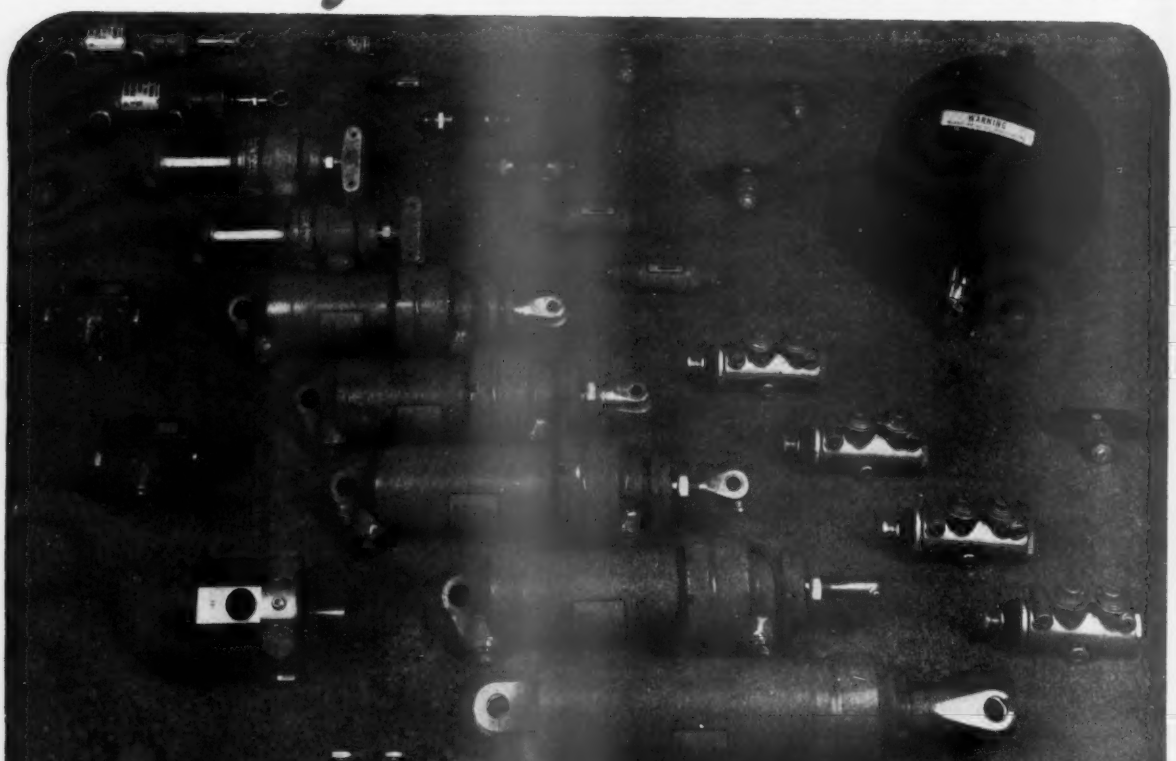
The span of this airplane is 55 m., and the wing has an area of 300 sq.m. It is 28.5 m. long, and its pay load is 12 long tons. The volume of the cargo space is 100 cu.m., enough to carry 130 fully equipped soldiers, or 55 barrels of gasoline, or two trucks with $2^1/_2$ tons of additional load, as well as large quantities of supplies and provisions. As a sanitary airplane, it can transport 60 wounded men in beds. It is powered by six Gnome-Rhone engines, but information is not given concerning the power rating of the engines. These are mounted on the wings, three on each side of the fuselage. The plane carries a crew of five, consisting of two pilots, two mechanics, and a radio operator. *Zeitschrift des Vereines Deutscher Ingenieure*, January 8, 1944, page 8, 2 illus.

Aeroplanes of the Swiss Air Force. In conjunction with a brief review of the development of military aviation in Switzerland, descriptions and specifications are given of current Swiss military aircraft types. The first unit of the Swiss air force was formed on July 31, 1914, and by 1918 the Swiss Flying Corps was well organized, with at least one squadron of military airplanes stationed in Zurich. Expansion of military aviation continued from 1924 under the command of the Swiss General Staff until 1936, when it was recreated as an independent service equal in status to the Swiss Army. It is estimated that the force now comprises 30 squadrons.

The equipment has included a number of foreign types built abroad and in Swiss factories under special license, but a substantial number of planes used are products of the domestic aircraft industry. The domestic companies and their products are outlined briefly. Specifications and illustrations are given of current types including the E.K.W. C-35, a two-seater fighter; E.K.W. Dewoitine D. 27, a single-seater fighter; E.K.W. C-36, a two-seater fighter bomber; and the E.K.W. Morane Saulnier Ms-406, a single-seater fighter. *The Aeroplane Spotter*, June 1, 1944, page 124, 4 illus.

Das Einsitzige Langsamflugzeug LF 1 und seine Flugleistungen (The Single-Place Low-Speed Airplane LF 1, and its Flight Performances). H. Winter. It is noted that the development of low-speed airplanes, which have a special purpose in warfare, has gained considerable momentum recently. A new type, whose flight performances are expected at least to equal those of the Fieseler Storch, has been designed. This article describes the general construction of this new airplane and its most important individual parts. Its flight performance measurements are discussed, with special attention to the take-off and landing runs, flying speeds at low wind velocity, and rate of climb. The size of the necessary landing space is determined. *Zeitschrift des Vereines Deutscher Ingenieure*, January 22, 1944, pages 43–46, 8 illus.

Muscles for the Black Widow



SPIDERS have muscles, too—these are the muscles for the Black Widow. Thirty Altair hydraulic units are used in the spectacular Northrop P-61 Black Widow. Pacific Division is justly proud that the entire hydraulic system incorporates and is built around these actuating cylinders and component controls that form the muscles on the world's largest pursuit planes designed specifically for Night Fighting. Pacific Division, Bendix Aviation Corporation, 11600 Sherman Way, North Hollywood, California.

Pacific Division
Bendix Aviation Corporation
NORTH HOLLYWOOD, CALIF.

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Airports and Airfields

Setting the Sights. Part II. Second in a series of articles presenting a method for estimating the cost of planned airfields. This second article furnishes a basis of computation for a Class II field having two runways suitable for operations of private planes and feeder-line aircraft. As in the preceding article, it contains a table of the maximum and minimum costs that may be expected for each major item of construction for the particular type of airport considered. *National Aeronautics*, July, 1944, pages 16, 17, 1 illus.

Airport Maintenance. Charles B. Donaldson. The Director of Airports of the Civil Aeronautics Administration discusses the problem of returning to peacetime usage approximately 600 new or improved airports constructed for war purposes. After brief remarks recommending that local government authorities be given the responsibility for operating and maintaining these facilities, and about the necessary financing arrangements, the article gives advice concerning the physical operation and maintenance of an airport. Attention is given to the work necessary in connection with pavements, drainage, field areas, lighting, buildings, and snow removal. Charts show the various classifications of airports and the number of each, with statistics concerning the length of runways, the largest airplane that can be accommodated, and the type of community each class is intended to serve. Drawings show typical airport layouts. *Aviation Maintenance*, July, 1944, pages 46–49, 144, 146, 150, 152, 154, 156, 10 illus.

New Hemisphere Airports Unite Americas Through Air-Borne Exchanges. Norris M. Mumper. The effect of present and postwar trends in airport expansion on the growth of aviation in Latin America are discussed. It is stated that scores of new airports have been constructed in the Americas in recent months and that they are bound to play an important role in bringing about closer economic, political, and spiritual relations among these countries. The rapid expansion of airports and air lines in Latin America is described. Anticipated increases in air transport in the postwar period are also discussed. Figures are quoted on the increase in airports in the United States, and problems of airport design and air-line operation are considered. *Air Transportation*, June, 1944, pages 10–17, 1 illus.

Alaska Flight-Strip Construction. Data are given on the eight flight strips built in Alaska and northwest Canada by contractors working for the Northwest Service Command of the U.S. Army. General specifications, period of time for construction, and cost of construction are included in the information, as well as an indication of some of the problems peculiar to the construction of each flight strip. The strips are located respectively as follows: No. 1, about 350 miles northwest of Edmonton; No. 2, north of Fort St. John; No. 3, north of the second flight strip; toward Fort Nelson, B.C.; No. 4, northwest of Fort Nelson; Nos. 5 and 6, east of Whitehorse; and Nos. 7 and 8, west of Whitehorse. *Commercial Aviation*, July, 1944, pages 92–94, 96, 5 illus.

Help Wanted. Leslie L. Schroeder. Minnesota's State Aviation Commissioner offers some observations on the legal and technical aspects of airport planning. Maintaining that the establishment and control of landing areas is recognizable as a public and Governmental function, he discusses the relative factors of utility and cost in five categories of airports: (1) the private airport used solely by the owner; (2) the private airport used by the public as well as the owner; (3) the municipal airport used largely for private purposes; (4) the municipal airport used primarily for public purposes; and (5) the publicly owned airport used exclusively for public and Governmental purposes. In the case of the airport constructed and operated by the municipality, it is his belief that greater attention must be paid to the utility of the airport and less to the cost. He states that if industry and Government will provide municipal airport planners with the necessary technical information and the legal tools with which to work, the United States will soon find itself equipped with efficiently planned and well-designed airports constructed well within the limits of sound local economy. *National Aeronautics*, July, 1944, pages 21, 22, 25, 26, 1 illus.

Airports for the West. Part I, The Situation Today and the Need. Beginning a series of articles investigating the requirements for postwar airport facilities in the western part of the United States and discussing some of the problems involved in the establishment of those facilities. In this first article the population of communities in western states is tabulated. However, the population analysis is qualified by reasons showing why population cannot be considered a direct index to airport requirements in the West. From C.A.A. figures and other sources, statistics on existing airports and those needed in the immediate postwar period are listed for each state. Existing facilities and requirements are broken down into the four different airport-type classifications. The grand total of existing airports in the western part of the United States is shown to be 1,038; the number needed is estimated at 1,940. *Western Flying*, July, 1944, pages 42, 43.

Coral Airstrips on Pacific Islands. N. A. Bowers. Methods of making good runway surfaces of coral, which have aided in the speedy construction of Pacific island airfields for bombers, are described in the first of a series of articles on the subject. The writer discusses methods of handling coral, desirable conditions for working with it, and the results accomplished. Consideration is given to the fundamentals of location, the problems that must be met by the Seabees, the maintenance of coral runways, and the use of asphalt for topping. *Engineering News-Record*, July 13, 1944, pages 80–85, 8 illus.

Report on Alaska. Joan David. Some of the problems involved in the construction and maintenance of Alaskan airfields are outlined. Three different groups of difficulties that are encountered are discussed: One, typified by the landing field erected by the C.A.A. at Northway in 1940, concerns airfields erected in the interior where the land is permanently frozen and the temperature falls as low as −70°F. The second, exemplified by the airport being completed at Gustavus, concerns airfields erected in the coastal area where the land is swampy and the temperatures are often quite warm. The third variation concerns the sea-ice landing field, such as are used at Nome and Kotzebue. The article also includes notes on Alaska's bush pilots (mentioning particularly Sig Wien) and on the increasing number of airways in Alaska. *National Aeronautics*, July, 1944, pages 23–25, 3 illus.

Maintenance of Rigid Type Pavements for Airports. Boyce H. Biggers and James P. Cockey. The types of failures that may occur in rigid-type pavements for airports in various climatic regions within the United States are described by two executives of the Engineering and Construction Division of the C.A.A. An explanation is given of how each type of failure can be recognized by the maintenance engineer or airport manager. The failures discussed include spalling, pumping, warping, and frost heave. Information is given about sealing of joints and the patching of concrete pavements. *Aviation Maintenance*, July, 1944, pages 64–66, 162, 168, 170, 172, 174, 16 illus.

Armament

Rocket Projectiles. The British Coastal Command is reported to be firing rocket projectiles from under the wings of low-flying aircraft as the main weapon against shallow-draught ships and as an antiflak weapon to upset the antiaircraft gunners while torpedo aircraft make their runs. The R.A.F. also employs the new weapon in low-level attacks against land targets such as bridges, gun emplacements, wireless stations, and military buildings. *Flight*, June 1, 1944, page 588, 3 illus.

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DESIGNERS AND BUILDERS OF COMBATANT TYPE AIRPLANES AND EXHAUST MANIFOLD SYSTEMS

Fire from the Sky. A description is given of the various types of incendiary bombs used in modern aerial warfare. It is explained that, for the most part, incendiary bombs are of the magnesium, thermate, phosphorus, and oil varieties, the largest weighing 500 lbs. Information is given about seven types of magnesium bombs, three sizes of fire bombs depending on jellied oil for their capacity to spread flame, and bombs containing white phosphorus. It is noted that one of the latest developments in incendiaries is the aimable cluster, which has a nose and a tail as though it were a single bomb. This permits the lightweight bomb to be aimed with precision. At the proper altitude, a time fuse explodes a primacord charge and opens the cluster. *Popular Mechanics*, August, 1944, pages 40–43, 8 illus.

Jerry's Field of Fire. J. D. Freudy. A survey of the location of guns on German aircraft with their angles and ranges of fire. The guns of the Dornier Do-17Z, 215, 217E; the Focke-Wulf FW 200K; the Heinkel He 111K, 115; and the Junkers Ju 52, 88-Al, 87, 88-A4 and A6, and 88B are reviewed. *Air News*, August, 1944, pages 21–23, 31 illus.

Radio-Controlled Rocket Bomb. A brief article giving additional details about the German crewless, radio-controlled, rocket-glider bomb that is launched from airplanes. The information was obtained by eyewitnesses stationed on convoys against which the weapon was employed. *Astronautics*, June, 1944, page 12, 1 illus.

Bombs vs. Shells. Willy Ley. In this article on air bombardment and artillery fire the writer explains the difference between demolition bombs and high-explosive shells in order to discuss their relative effectiveness. The conditions under which each may be used effectively are outlined. *Mechanix Illustrated*, August, 1944, pages 44–46, 149–151, 6 illus.

Business and Finance

Industry's Sales Soar . . . But Not Profits. Raymond L. Hoadley. Reviewing the 1943 financial statements of 14 representative aircraft-manufacturing companies, the writer interprets the conditions they indicate for the stock investor. It is his opinion that the overall financial picture represented by the 1943 statements presages the solvency of the aircraft-manufacturing industry during the critical peacetime reconversion period. In summary, he reports that the statements show: For the first time since the United States entered the war the average company's cash position was larger than the taxes it owed; postwar adjustment reserves had increased about 60 per cent; current assets had increased more than current liabilities; inventories and bank debts were higher, while the profit margin on sales was the lowest of all America's large industries except

one. The writer's observations are supplemented by a recapitulation table of the 14 companies' statements. The table lists the 1942 and 1943 sales, net earnings, net purchase price of stock, dividends, and inventories of each company. *Aviation*, July, 1944, pages 197, 271, 272.

Downtrend in Airline Earnings May Soon be Reversed. "Roger Wilco." Air-line operations for 1943 and 1944 are analyzed to show why profits have fallen short of the 1942 level and also to reveal the circumstances under which a reversal of trend may be anticipated. It is claimed that the responsibility for lower net earnings in the industry as a whole may be charged to the fact that operating expenses have increased at a far greater pace than gross revenues. Factors that have contributed to this condition are stated to be wage rises, costs of training replacements for anticipated draft removals, costs of building organizations for expansion programs, increased prices of fuel and other materials, taxes, reduced air-line rates, and unfavorable revision of Army contracts. In proving its point, the article discusses the financial reports of individual air-line companies. However, it is predicted that air-line profits will increase again if commercial lines are allocated additional transport planes, since overall operating costs per unit can be decreased by the use of more planes with which to accommodate the heavy volume of business. *Air Transport*, July, 1944, pages 56, 59, 60, 1 illus.

Civil Aviation

What Can Be Done About Plane Noises? Charles Evans. A brief article discusses the matter of noises emitted by airplanes, with particular reference to the action that can be taken by public authorities when large numbers of airplanes are in flight in the postwar period. Cases are discussed in which legal action has been taken by property owners in the locality of airports to restrain the operation of aircraft because of the disturbance resulting from aircraft noises. It is noted that, while engines can be muffled for ordinary civilian use, most of the noise made by the airplane is caused by the propeller, and suggestions are made for changes in propeller design that would result in less external noise. The subject is regarded as one requiring consideration by the aircraft manufacturers, air-line proprietors, and legal authorities, in view of the many thousands of airplanes expected to be in use by private owners and for transporting passengers, mail, and cargo within the next few years. *Automotive News*, July 10, 1944, page 22.

Fly-It-Yourself. R. S. Robie. The president of the American Drivurself Association proposes that a "Fly-It-Yourself" plane-rental program be adopted as an adjunct of the "Drive-It-Yourself" industry. He points out the feasibility of and economic need for such a service, tells how it would operate, and describes the type of plane that would be required for it. An advertising campaign and a rate structure for the contemplated "Fly-It-Yourself" program are also discussed. *Canadian Aviation*, July, 1944, pages 40–43, 7 illus.

Safety Simplified. Jesse W. Lankford. An explanation of why it was necessary to revise the Civil Air Regulations. The objectives and methods of the Civil Aeronautics Board's Safety Bureau in instituting proposed changes in Part 60 (Air Traffic Rules) are outlined. *National Aeronautics*, July, 1944, pages 19, 20, 2 illus.

Flying Packhorse. John A. Willard. An account of how the Montana game-conservation department carries salt to wild game by means of airplanes. Advantages of transporting the salt by plane rather than by other methods of conveyance in rugged mountain territory are demonstrated. Using the salting operations as an example of the airplane's civilian utility, the writer indicates similar applications for air transport. These include stocking lakes and fish planting, trailing game violators, spotting forest fires, observing snow and range conditions, and counting wild game. *Western Flying*, July, 1944, pages 52, 53, 102, 3 illus.

Control Equipment

Automatic Power-Unit Controls. Joseph Lowrey. The writer divides power-unit controls into three main classes: (1) primary controls, by which the pilot normally governs the available thrust horsepower, such as throttle-and-propeller-pitch controls; (2) secondary controls, which must be operated to insure that the required performance is obtainable in response to throttle movement, such as carburetor mixture, superchargers, and air cleaner by-pass controls; (3) tertiary controls, which have little or no effect on engine performance but are necessary if continued satisfactory engine running is to be obtained. These include main-radiator controls, oil-radiator controls, and carburetor hot-air intake controls. Each class of controls is discussed, as well as numerous auxiliary controls not falling within these classes. In conclusion it is stated that the ideal fully automatic power unit remains a thing of the future but is steadily

Surface Combustion instructor explaining a cutaway model of a Janitrol Aircraft Heater in a Navy Training School.

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being approached. *Aircraft Engineering*, June, 1944, pages 160–162.

Controls Design Considerations. F. A. Matthews and K. D. Remington. Control-cable systems are examined from the standpoint of design considerations. It is stated that cable stretch is important only when it becomes excessive, in view of prevailing specifications which require that no more than 20 per cent of surface travel can be lost because of structure and cable deflection. The formula for cable stretch is explained. Analyses of control systems of large airplanes show that approximately as much cable travel is lost through deflection of the brackets and supporting structures as through cable stretch itself. For that reason, a modification of the formula is suggested to allow for such structural deflection. Special cables are mentioned, having properties as set forth in a table accompanying the article. A typical example of a stretch and deflection problem is given, with an explanation of the calculations to be made and the allowances for friction, stretch temperatures, rig load, and other factors. Various mechanical devices and regulators are described. In conclusion, the writer advises that it is better to design the system to obtain the maximum mechanical advantage at the extremities of travel, this being the best condition for flight loads, but care must be taken to assure that too low a mechanical advantage is not obtained in the neutral position. *Aero Digest*, July 15, 1944, pages 84, 86, 88, 205, 2 illus.

Remote and Automatic Electric Controls for Aircraft. William P. Lear. The development of aircraft controls is reviewed, and methods of operating modern aircraft controls are outlined. The writer, President of Lear, Inc., discusses aircraft electric remote-control actuators, reaction units, methods for the remote control of electromechanical actuators, the electromagnetic "Fastop" clutch and brake, and preset positioning controls. Both the a.c. bridge-type positioning control signal and the Selsyn type of positioning control signal are analyzed. Other sections of the article deal with the general theory of automatic controls and the automatic controls aboard a modern aircraft. *Journal of the Franklin Institute*, July, 1944, pages 9–35, 13 illus.

Deicing

De-Icing Control. It is stated that because of unpredictable icing conditions each part of an aircraft requiring deicing needs special equipment to suit the application. This generally results in a variety of equipment, each having a special control. The conditions that give rise to icing in the induction system of the engine are outlined. Methods of induction-system deicing are discussed. It is noted that all methods of heat application lower engine efficiency by reducing the weight of charge inducted. In addition, the overall operating temperature is increased, which is again undesirable.

The writer states that the best method is by an inhibitor, usually an alcohol mixture, which is injected into the carburetor adjacent to the jet when required. The rate of injection must be 40 pints per hour per 1,000 hp. As it is impracticable to inject such fluid continuously (mixture settings are affected), this method must depend on an accurate and reliable indicator and preferably made automatic in operation. A moving vane indicator fitted to the engine induction elbow, which automatically applies an inhibition to the jet chamber, is illustrated. Air-frame deicing is discussed and a mechanically operated ice indicator capable of distinguishing between soft deposits and harmful hard deposits is shown. *Modern Transport*, June 3, 1944, page 7, 3 illus.

Anti-Icing System. This article deals with the field service and maintenance of a typical four-engine anti-icing system used to prevent formation of ice on aircraft carburetors, propellers, windshields, and pitot tube. It describes the parts of such a system, notes their functions, and suggests maintenance procedures for keeping them at their maximum efficiency. Indicating the troubles that commonly occur in individual parts of the anti-icing system, the article tells how to prevent, locate, and adjust them. Schematic drawings illustrate the construction and operation of the system's components. *Air Tech*, August, 1944, pages 38–41, 70, 8 illus.

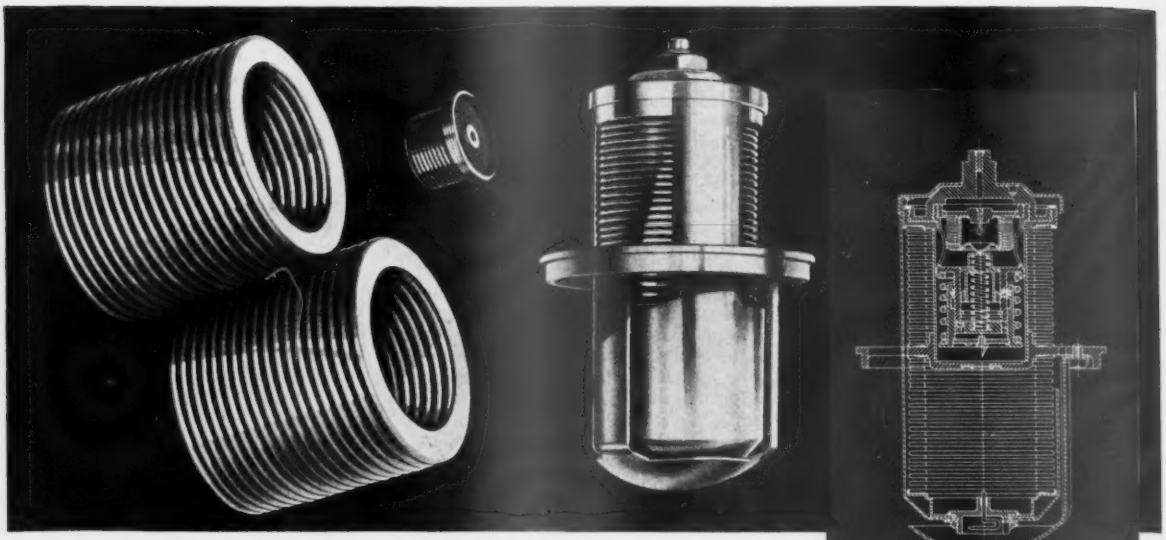
Design

Boeing B-29 "Superfortress." Herb Powell. This is a comprehensive article summarizing available information about the B-29 bomber. It contains not only structural, design, and engineering details of the Superfortress but also data on how the plane is manufactured. Among the design features that are noted particularly are the pressurized cabin, the airfoil section developed for greater range performance, and the dual nose wheel. To demonstrate the construction of the wing, the progress of the right-hand front wing spar chord is traced, department by department, from the time it is received at the Boeing-Wichita warehouse until it reaches its ultimate position in the Superfortress. Various firms that have contributed to the manufacture of the B-29 are listed. A tabulation of the aircraft's specifications and performances precedes the article. *Aviation*, July, 1944, pages 110, 111, 278–281, 283–285, 4 illus.; "Some B-29 Design Features," *Automotive and Aviation Industries*, July 15, 1944, pages 32–34, 7 illus.; "And Now the B-29 'Superfortress,'" *Aero Digest*, July 1, 1944, pages 70–75, 140, 14 illus.; "The Superfort," *Western Flying*, July, 1944, pages 44, 45, 84, 6 illus.; "Superfortress," by Tom Ashley, *Southern Flight*, July, 1944, pages 24, 25, 52, 8 illus.; "B-29, the Boeing Superfortress," by Michael H. Froelich, *Industrial Aviation*, July, 1944, pages 30A–30D, 6 illus.

Britain First—Perhaps. By "c_2n_2-o_2hg." Specifications of the seven British postwar commercial transport types announced by Lord Beaverbrook are criticized. It is claimed that, while these aircraft will not be produced in quantity until 1946, their planned performance abilities have been attained already in other planes and will be on the way to obsolescence by the time the seven British types are ready for active use. The suggestion is made that commercial transport pilots should be consulted before specifications for commercial transport aircraft are approved. *The Aeroplane*, June 23, 1944, pages 695, 696, 2 illus.

Sub-Standard System for Plane Parts. J. A. Grutzius. Lockheed Aircraft Corporation's system of creating and using substandard parts is outlined. It is explained that a substandard is a part or assembly designed by the company, bearing a company number, and peculiar only to the company's airplanes rather than to aircraft generally. In order to become a substandard, it is stated that a part must be proved in use on one or more contracts or models and have the approval of the manufacturing-planning, standards, and production-design engineering departments. Design and manufacturing economies engendered by the employment of substandard parts are indicated and examples of substandards are cited. *Aero Digest*, July 1, 1944, pages 114, 128, 1 illus.

The North American P-51 "Mustang." William R. Nelson. Profusely illustrated with schematic drawings, this is a design analysis of the North American P-51 Mustang fighter. Part by part, the engineering details of the aircraft are examined. Dimensions and leading particulars are listed, while sectional views of the various components and systems are shown with identifying nomenclature. With regard to performance, the Mustang is reported to have been credited as the best low-altitude cooperational craft, the most versatile dive bomber, the fastest high-altitude fighter, and the plane with the greatest range among single-seater, single-engined fighters. *Aviation*, July, 1944, pages 127–147, 35 illus.; "Design Breakdown of the P-51 Mustang," George Gehrkens, *Industrial Aviation*, July, 1944, pages 7–19, 70, 21 illus.



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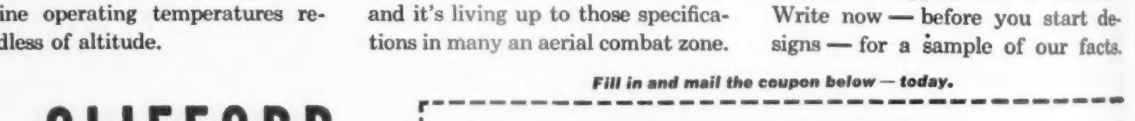


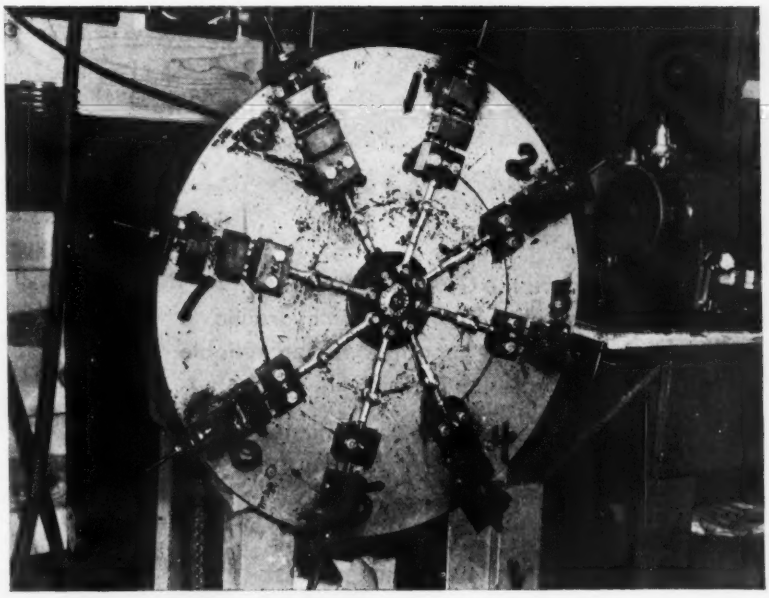
Structural Features of German Aircraft. D. M. A. Legett and J. H. H. Davison. Following a historical introduction to the subject, the writers analyze German fighter and bomber design and then describe special design features of German aircraft. Fighter designs considered include the Me 109, 110, 210, 410; the FW 190; and the Hs 129. The design of the Do 217 and Ju 88 bombers is reviewed. Special features of German aircraft are summarized and discussed in sections dealing with electric and hydraulic systems, tanks, castings and welding components, engine mountings, materials, surface protection, spot welding, access doors and engine cowling, and provisions for inspection and maintenance. Consideration is given to the design efficiency of German aircraft and to the design from the standpoint of production and maintenance.

In conclusion it is stated that from the structure-weight standpoint the impression gained is that with the exception of the FW 190, German designs are sound without being brilliant or embodying novel forms of construction which it might be tempting to copy. But with regard to design for ease of production and maintenance, great efforts have been made and considerable success achieved. Discussions occupy the final seven pages. *The Journal of The Royal Aeronautical Society*, June, 1944, pages 167–201, 29 illus.

Standardisation of Components. Cyril May. The story of how British aircraft technicians have achieved the standardization of aircraft parts. It is explained that the achievement has saved the country innumerable man-hours and has important applications to postwar development and manufacture. *Aeronautics*, July, 1944, pages 60, 61.

Design for Airline Operations. W. W. Davies. An air-line research engineer gives his views on the specialized types of planes that will be required for air-line operation five or six years after the war is over. The specifications he outlines are for a transoceanic plane of between 125,000 and 150,000 lbs. gross weight; a domestic-market de luxe sleeper- and day-plane combination of between 70,000 and 80,000 lbs. gross weight; a domestic standard sleeper- and day-plane combination of 50,000 to 60,000 lbs.; a trunk-line feeder plane weighing between 30,000 and 35,000 lbs.; a domestic off-line feeder craft in the 15,000- to 20,000-lb. class; and an all-cargo airplane of 30,000 to 35,000 lbs. The writer also reports on United Air Lines' program of design studies for improving passenger, cargo, and crew accommodations. *Airlanes*, July, 1944, pages 6, 18, 3 illus.

Converting the Coronado. Harold Keen. Exemplified by operations at the Rohr Aircraft Corporation's flying-boat base in Chula Vista, Calif., an account is given of how Consolidated Coronado bombers are converted into cargo transports. Procedures of stripping, rerouting cables, relocating equipment, and installing new apparatus are noted. In addition to a review of the Coronado's dimensions, the article also includes an explanation of why conversion from bombers to cargo planes is economical and expedient. *Flying*, August, 1944, pages 42–44, 156, 6 illus.; "Flying Barge," by Lt. Charles Q. Mohan, *Skyways*, August, 1944, pages 50, 51, 88, 2 illus.



Rotary tension fatigue machine developed by Convair engineers. Eight specimens can be tested at one time. The motion of the machine is similar to that of the piston arrangement of a radial aircraft engine.

Design Considerations of the Cargo Airplane. Carlos Wood. Some considerations affecting the design of the cargo airplane are discussed. It is shown that basically the structural design of floors, tie-down equipment, and the like is dependent only on the maximum allowable cargo load and the maximum available cargo volume. Analysis indicates that the actual operations of the cargo airplane determine the relative importance of speed of loading and weight. Speed is essential in short-range operation, but minimum weight is essential in long-range operation.

It is suggested that reduction of rates can make air cargo a really big business, capable of affecting the prosperity of this country and the rest of the world. The writer states that rate reduction is not only possible but necessary, since air cargo can be a powerful instrument of trade and commerce which may be used to promote and preserve world peace. *SAE Journal*, July, 1944, pages 303–309 (Transactions), 16 illus.

A Generation of American Fighters. Part II. Martin Caidin. Concluding half of a two-part article tracing the evolution of American fighter-plane design. Data are given on fighters that filled the gaps between announced plane designations, as well as those that were put into quantity production. Part II is concerned with the development of fighter planes from the P-35 through the P-71. *Air News*, August, 1944, pages 33–36, 69, 18 illus.

Physiological Aspects of Flying Control. W. E. Hick. In this article the possibility of a scientific study of the physiologic aspect of flying-control design is introduced, and, as a starting point, the principles on which the nervous system functions are briefly outlined. The nature of voluntary movements is discussed, with particular reference to the influence on them of reaction time and muscle elasticity.

A method of approach to the study of machinery controls in general is suggested, with reference mainly to such questions as velocity ratio, control force, and friction. The manner in which an airplane responds to a disturbance, such as a control movement, is described briefly in general terms, and the psychologic significance of oscillations is discussed. Disturbed motion in the plane of symmetry is used as an example to show that, if certain assumptions are accepted, it is advantageous to make the control sensitivity low in the middle of the range, although that inevitably implies a high sensitivity near the extremes. Choosing control movement rather than force as the determinant of sensitivity, a velocity ratio increasing toward the extremes is advocated as a solution theoretically favorable with regard to precision and going some way toward reducing excessive control forces at high speeds. *Aeronautics*, July, 1944, pages 34–40, 8 illus.

ABOARD THE GRUMMAN "Hellcat"

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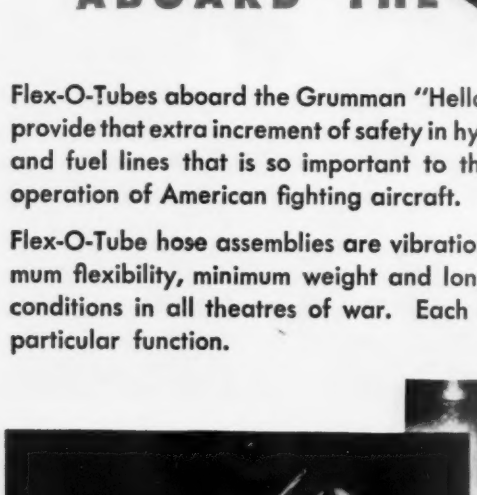

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Electrical Equipment

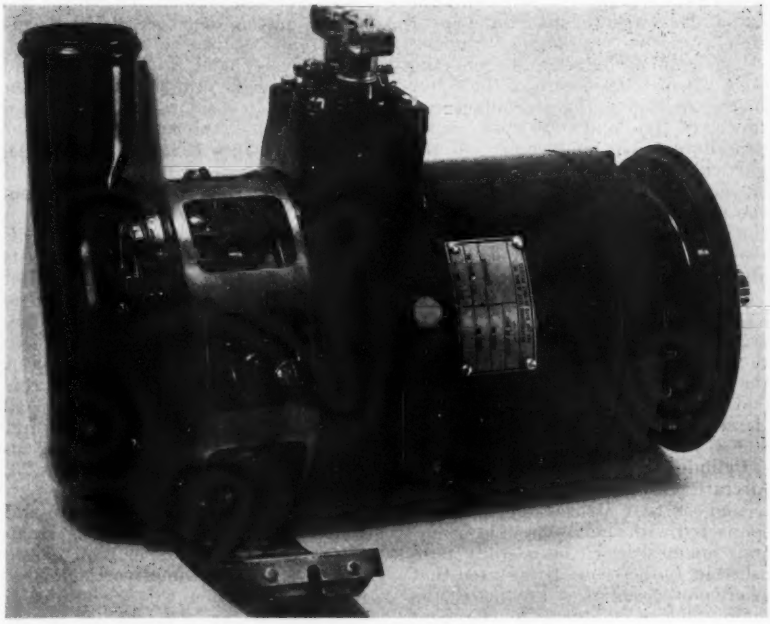
Aid to Quality Control in the Manufacture of Aircraft Generators. F. M. Potter. It is stated that aircraft generators are designed for high output, low weight, small size, and wide speed range, and these limitations do not permit normal allowances for material and manufacturing variations. Small variations in the material and manufacturing processes result in wider variations in output characteristics than in conventional machines. The writer discusses certain of these variations and their effect on the output characteristics. Means of controlling and checking these factors are discussed. *Electrical Engineering*, July, 1944, pages 525–529 (Transactions), 15 illus.

Determining Intermittent Ratings. H. Rissik. This article discusses the determination of the equivalent rating of a machine—that is, the continuous load, whether expressed in terms of current or power—which will produce the same final temperature rise as is actually produced by the given intermittent load. In approaching the problem as applied to an air-borne electrical auxiliary, the writer devised a simple graphic solution that lends itself to routine use. He outlines the temperature-rise theory and describes a rapid and accurate method of determining the heating and cooling time constants from test results. *Aircraft Engineering*, June, 1944, pages 164–170, 13 illus.

Blast-Tube Cooling for Aircraft Generators. Cyril G. Veinott. The fundamentals of blast-tube cooling for generators are explained through the use of established principles of hydraulics. It is shown that the pressure-volume curves of a blast tube can be determined by flight tests and that the pressure-volume curve of a generator can be determined in the laboratory. From the two pressure-volume curves the airflow through the generator in flight can be predicted without an actual flight test on the generator.

The writer states that this procedure would save many flight tests if pressure-volume curves of various blast tubes were available. It is shown that the pressure-volume curves of a blast tube can be determined by open-end and closed-end readings on the blast tube, and the complete curve can be expressed in terms of two constants readily determined from these readings. Once values of the constants are established, air-flow calculations become as simple as the application of Ohm's law. The theory also covers generators with an internal fan. A plea is made for accurate blast-tube data and for better specifications on blast cooling. A suggested form of blast-tube specification is given. *Electrical Engineering*, July, 1944, pages 520–524 (Transactions), 6 illus.

New Lightweight Generators Develop Greater Power. J. D. Miner. Progress made in the past 4 years in the design and construction of aircraft generators is reviewed. It is shown that the power rating has increased from a maximum of ¾ kw. with a weight of 38 lbs., to the present 6-kw. units weighing less than 36 lbs. and 9-kw. generators weighing less than 48 lbs. Such advances have been achieved by careful attention to all details of mechanical and electrical design. Reasons are given for the greater difficulty of problems of mechanical design than those of electrical design, one of these being the lack of adequate data regarding the vibration frequencies associated with various engine-propeller combinations. Studies of the effects of vibration on generator design, construction, and performance are described, with information concerning provisions for overcoming the forces that act on the mountings, end brackets, cable connections, and drive mechanisms. Other points to which attention must be given are commutators, brushes and brush holders, terminals for heavy-current generators, armature shafts, ventilation, and provision against centrifugal force. Magnetic and mechanical properties of the frames and pole pieces are discussed, and eight specific advantages of a large number of poles are listed. The characteristics of different methods of winding and insulation are dealt with at length. In conclusion, the writer states that one of the most important possibilities for improvement is in better ventilation, and he gives some predictions of developments that may be expected within the next few years. *Aero Digest*, July 1, 1944, pages 108, 110, 112, 121, 124, 126, 128, 6 illus.



A Westinghouse 28.5-volt, 200-amp., low-speed aircraft generator designed to provide maximum endurance for service under conditions of extreme vibration. The usual light-alloy bracket is shortened and brush-access openings are provided directly in the steel frame.

A Unit for Balancing the Voltages of Three-Phase Aircraft Inverters Supplying Large Single-Phase Loads. Sydney Wimpie. A means of reflecting a single-phase load so that it appears as a balanced three-phase load to the power supply is discussed. A balancer of this type, designed for use in aircraft, is described and its characteristics are considered. *Electrical Engineering*, July, 1944, pages 532, 533 (Transactions), 7 illus.

Engines

Engines for Feeder-Line Aircraft. The engine requirements for relatively light airplanes for providing feeder services to main trunk lines are discussed. It is stated that from the points of view of economical operation, low maintenance costs, a good power ratio, and simple mechanical attention, there seems little doubt that the air-cooled engine will remain pre-eminent for feeder-line aircraft. The problem of whether air-cooled power units should be of the in-line or radial type is considered. A comparison is made of three types of radial engines, the Alvis Leonides, Armstrong-Siddeley Cheetah X, and the Lycoming R. 680B, with the de Havilland Gipsy Six of the in-line type. *Modern Transport*, July 8, 1944, pages 7, 8, 4 illus.

Hercules Engine Components. J. A. Oates. As carried out at one of Britain's "shadow" factories, methods of producing various components of

the Hercules engine are detailed. This article deals with the machining operations on the crankcases, impeller, sleeve, cylinder barrel, and connecting rods. It includes details of the equipment used for the manufacturing processes and comments upon certain procedures that are peculiar to this particular factory. Operations are traced from the milling of the sides to the production of the cylinder bores, the crankshaft bore, the layshaft and sleeve-crank bores, the impeller pockets, the master connecting rods, and the articulated rods. The article also specifies how the cylinder sleeve, the eccentric belt, the external surfaces of the cylinder barrel, the propeller shaft, the sleeve cranks, the spindle drive, and the reduction gear case are made. *Aircraft Production*, July, 1944, pages 309–319, 35 illus.

Cylinder Arrangement of 4000 hp. Aircraft Engines. Part II. The second of two articles on problems connected with the design of large aircraft engines, based on a study published in *Luftwissen*. It is stated that where power is increased by increasing the number of cylinders, development must be based on firmly established practice in the design of in-line and radial engines. The special features of both types are analyzed. A key plan of various layouts for a 4,000-hp. power plant is presented. Specifications are tabulated for several different arrangements for engines of this size, based on b.m.e.p. of 200 lbs. per sq.in., piston speed of 2,750 ft. per min., and stroke-bore ratio of 1.1. The development principally aims at elucidating the crankshaft layout, the paramount consideration being a low frontal area. *Automotive and Aviation Industries*, July 1, 1944, pages 42–44, 1 illus.

Confusion on Horsepower Output Due to Engines' Varied Ratings. A commentary explains why one aircraft engine may be labeled with several sets of performance figures. The writer discusses the take-off rating, horsepower output at different altitudes, cruising power, military power for combat, and War-Emergency power. Recent statements of manufacturers regarding engine output are analyzed. The horsepower per cylinder of different aircraft engines is discussed. *Aviation News*, August 7, 1944, pages 23, 24.

Engine Cooling Fan Theory and Practice. Kenneth Campbell. In an article based on a paper read before the Society of Automotive Engineers, reference is made to the limitation that the cooling problem has placed on engine and airplane performance. It is stated that cooling fans offer important improvements in airplane performance.

The writer defines the "cost" of cooling in terms of loss of thrust horsepower consumed in cooling the engine and works out formulas for calculating that loss. Allowances are made for the power consumed in forcing the stream of cooling air through the internal passages of the engine compartment, and the effects of such drag factors on airplane performance are measured. Efficiencies of fans, propellers, cowling, and other components are considered, as well as the other variables that enter into the problem. Descriptions are given of fan designs of recent past years and of the tests to which they were subjected. A new design of fan developed at the fan-test laboratory of Wright Aeronautical Corporation is described in considerable detail. Charts and sketches facilitate the explanations contained in the text, and a table shows an analysis of performance gains obtained by the use of fans. *Industrial Aviation*, July, 1944, pages 24, 26–30, 72–74, 10 illus.; "Fan Cooling 'Ups' Engine Performance," by Kenneth Campbell, *Aviation*, July, 1944, pages 148–151, 258–261, 10 illus.

The Birth of an Eagle. A story of the development of the first series of Rolls-Royce Eagle aircraft engines. It is related how, by attention to detail and concentrated experimental work, a unit originally intended to give 200 b.hp. at 1,300 r.p.m. was developed to give 365 b.hp. at 2,000 r.p.m. with practically no increase in weight. The article includes some data on the Rolls-Royce Falcon engine, which was developed during the

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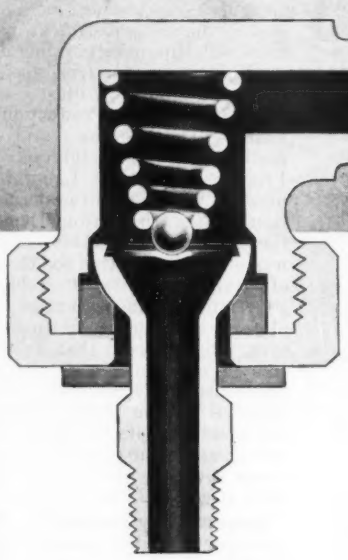

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same 1914–16 period, and is supplemented by a full-page schematic drawing of the Eagle VIII engine. *The Aeroplane*, June 16, 1944, pages 674, 675, 1 illus.

Radial Engine Cooling. A cooling fan for radial engine installation is described. Developed by Rotol, Ltd., this fan is reported to fulfill cooling requirements when the aircraft is climbing at full power or while the engine is running at high speed on the ground. The fan is multibladed and is designed to be positioned in the annular space between the leading edge of the engine cowl and the trailing edge of the propeller spinner. Mounted on and driven by the spinner it consists of a ring to which the blades are fitted in such a way that the blade angle is readily adjustable for optimum cooling under any climatic conditions. *Aircraft Production*, July, 1944, page 331, 2 illus.

Flight Technique

Add Another "Factor X." William D. Strohmeier. A study of the gyroscopic effects of a propeller in turning flight. The writer explains why, in a right turning stall, the left wing of an airplane drops violently just as the stall develops whereas in the left turning stall the right wing does not drop; why, in the right chandelle, there is a pronounced overbanking tendency, while in the left chandelle there is not; and in a steep level turn to the right, why there is a forceful overbanking tendency, while little of this tendency is apparent in a steep level turn to the left. *Air Facts*, August, 1944, pages 45–48.

Flight Testing

Flight Testing with a Propeller Thrustmeter. George W. Brady. In this paper the writer discusses thrustmeter design, calibration, flight instrumentation and procedure, test results, and body-propeller interaction. He then summarizes the usefulness of the thrustmeter and concludes with the observation that use of shaft-thrust measurements in routine flight-testing to check calculated airplane performance does not appear practicable until additional data have been obtained by which the several corrections can be more accurately determined. He asserts, however, that the thrustmeter does have important value in determining the relative efficiency of different propellers. *SAE Journal*, July, 1944, pages 318–326 (Transactions), 17 illus.

Gliding and Soaring

The Briegleb BG8 Sailplane. William G. Briegleb. A review of the development of the Model BG8 two-place sailplane. It is noted that the BG8 was originally designed for home builders but that it is not so simple to build as its predecessors, the BG6 or BG7. The construction of the BG8 is of wood. The wings are of the monospar type with built-up and plywood ribs. Wing covering is of $^3/_{32}$- to $^1/_{16}$-in. poplar plywood. The fuselage is semimonocoque with three spruce longerons and $^1/_8$- to $^3/_{32}$-in. plywood skin. The elevators and rudder are provided with controllable trim tabs accessible from either cockpit. *Gliding*, June, 1944, pages 8–10, 1 illus.

How Can We Get a Glider? Paul A. Schweizer. Possible means of obtaining gliders for clubs, school systems, and youth programs are discussed. It is noted that because of war conditions no new gliders are being produced for civilian use. Methods of obtaining gliders suggested and discussed include the use of available rebuilt equipment, the construction of new gliders, and the securing of surplus Army and Navy gliders. *Gliding*, June, 1944, pages 2, 3, 14, 16, 3 illus.

High-Altitude Flying

Cold—R.A.F.'s Other Enemy—Is Beaten. Air Vice-Marshal G. L. Keynes. Reporting that frostbite acquired during flight has ceased to be a cause of disability in the R.A.F., the writer surveys various means adopted by the R.A.F. to protect its fliers. The use of special combinations of gloves, leather suits with beaver-fur linings, fleece-lined boots, electrically heated suits, and chemical hot packs are discussed. Other methods noted are the avoidance of moisture inside clothing, particularly in gloves and boots; the mandatory use of oxygen masks at all heights over 10,000 ft.; and mechanical devices for distributing heat throughout the fuselage. *The Military Surgeon*, July, 1944, pages 3–5.

Hydraulics

Cleaning Time Cut in Half for Hydraulic Fluid. A hydraulic fluid pump filter made from scrap materials is described. The device is credited with reducing cleaning time to half and having the ability to remove even discoloration from hydraulic fluid. With it, fluid from the hydraulic system of an airplane is drained into a container within which an automobile oil filter of the replaceable-cartridge type is mounted. A pump draws the fluid through an intake valve and forces it through the filter and on through a rubber hose to the desired opening in the plane's hydraulic system. Another tube carries the by-pass fluid back to the container. *Air Transport*, July, 1944, page 55, 1 illus.

Calculations of Flow Velocity from Fluid-Flow Friction Diagram. R. C. Binder. The writer shows how additional coordinates placed on the well-established fluid-flow friction diagram make possible a direct calculation of the flow velocity in pipes and fluid couplings. The method makes it possible to determine directly the velocity factor, needed for calculating the torque transmitted through a fluid coupling, and the power at each shaft. *Product Engineering*, July, 1944, pages 466, 467, 3 illus.

Hydraulic Systems. Ed. W. Hudlow and Frank P. Davis. Two executives of the General Inspection Division of the Civil Aeronautics Administration give instruction concerning the fundamentals of hydraulic systems for the benefit of maintenance men. After a brief discussion of principles of hydraulic power, the different types of equipment are classified. This is followed by a list of definitions and explanations of the components of hydraulic systems and the terms used in describing them. The tabulation is classified under the heads of hydraulics, hydrostatics, hydrokinetics, and hydrodynamics. The article concludes with a "Know How" question-and-answer quiz on hydraulic systems. *Aviation Maintenance*, July, 1944, pages 61–63, 134, 136, 138, 140, 142, 12 illus.

Inspection

Accurate Inspection of Magnesium Alloy Castings. Robert Taylor. It is shown that there are pertinent factors that must be considered before any final conclusion can be drawn from the radiographic examination of magnesium-alloy castings. The correlation of X-ray testing, metallographic inspection, and subsequent operations that will eliminate peripheral defects are discussed. *The Iron Age*, July 13, 1944, pages 55–58, 7 illus.

First Aid For Production Headaches. The functions and working methods of Consolidated Vultee's Process Inspection Laboratory are noted. A service unit under the direction of the Inspection Department, the Process Inspection Laboratory was originally created for the purpose of investigating spot welding and governing the inspection of cleaning, plating, and anodic solutions. However, it is reported that its work has come to encompass a number of other diversified activities. Brief data are included on the physical location of the laboratory, its equipment and personnel, and some of the problems with which it deals. *Western Flying*, July, 1944, page 66, 2 illus.

Inspection by Projection. The application of Hilger projection equipment to the checking of quantities of small components is described. The method involves the use of a simple fixture to permit the component to be projected against a template. The template can be specially drawn to suit each application or reproduced photographically on glass to provide a record that can be duplicated at any time. Advantages of the method for quantity production are outlined, and its use for checking the profile and dimensions of spark plugs is described. *Aircraft Production*, July, 1944, pages 307, 308, 6 illus.

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Instruments

Balancing the Vertical and Gimbal Ring Assembly of the Sperry Directional Gyro Indicator. George R. Ford. A system developed by the writer for balancing the vertical and gimbal-ring assembly of the Sperry directional gyro indicator is described. The method is based on shifting weight from the heavier arc of the dial to the lighter arc. Examples are given of unbalance and of the corrections applied. *Instruments*, July, 1944, pages 409, 410, 3 illus.

Aircraft Load Calculator. C. F. Comstock. A description is given of an aircraft load calculator designed by the writer to facilitate calculations and to permit visualization of the loading process. The particular example described was developed for the Fairchild AT-21. *Weight Engineering*, Summer, 1944, pages 18, 36, 1 illus.

Aerial Eavesdropper. Charles Corddry, Jr. This article is about a magnetic wire recorder that reproduces conversations and noises occurring during flights and battles. Developed under the auspices of the C.A.A., the recorder was first used for studying flight-instruction technique. It operates on a magnetic principle and reproduces sounds on a fine steel wire, $^{4}/_{1,000}$ in. in diameter. *Flying*, August, 1944, pages 67, 68, 152, 4 illus.

Fluorescent Lighting of Aircraft Instruments. Major A. D. Direksen. The writer discusses the application of fluorescent markings for the dials of aircraft instruments as an improvement over former methods of instrument-panel illumination. The advantages of the use of near-ultraviolet rays to activate the fluorescent and luminous markings to produce a uniformly illuminated instrument panel with no apparent visible light in the cockpit are explained. The statement is made that the most efficient source for this radiation is the blue fluorescent lamp with a special blue phosphor powder. Various methods for applying fluorescent illumination are reviewed, and the development of the first successful lamps of this type is traced.

It is shown how various difficulties were overcome and how the present 24-volt d.c. blue fluorescent lamp was developed, together with the simplification of the system and its control mechanism. A recent development involves the use of an iris-type light shutter to reduce the light output instead of dimming by rheostatic control, this type being designed to give selected visible and ultraviolet light by rotating the filter-housing cap. Other current developments include a retractable cord, a self-starting lamp circuit, and a suitable headband for a bombardier, to which is attached the ultraviolet lamp for illuminating the fluorescent markings of the bombsight and other equipment, freeing the bombardier's hands. *Electrical Engineering*, July, 1944, pages 247–249, 6 illus.

Maintenance

Refeathering Navy Wings over the Pacific. Fred H. Colvin. A series of notes describes some typical airplane-overhaul methods that are employed by the Naval Air Bases at Alameda and North Island for the repair of damaged Navy planes. As related, every effort is made at both air bases to simplify overhaul routines and to handle work on a production-line basis as far as quantities in process permit. In addition to photographs and diagrams illustrating procedures and equipment, the article is supplemented by a list of the plane parts that are checked before overhaul. *Wings*, August, 1944, pages 1144–1148, 18 illus.

Engineering Service for Airlines Founded. E. J. Foley. The writer describes the idea of a firm that is considering the possibility of offering to air carriers complete "maintenance engineering." It is stated the purpose apparently embodies the idea of consolidating the technical work of at least several air lines, and the handling of the whole job by this single independent agency. *American Aviation*, July 15, 1944, pages 66, 69, 1 illus.

Hi, Fellah! Joe Chase. Some advice is given on how to improve line service for airplane pilots stopping at an airfield to park, obtain gasoline, etc. The suggestions include such elementary service hints as "guide him into the parking line," "clean his windshield," "keep your tools handy," and "use clean implements for oil checks." *Air Facts*, August, 1944, pages 30–32.

Management

A Modern Application of Cost and Budgetary Controls. P. B. Crouse. Consolidated Vultee Aircraft Corporation's system of operating controls, which has been under development for the past 3 years, now embraces a fully coordinated system that is being applied in all divisions of the corporation. The scope of the system is indicated, and particular emphasis is placed on the correlation of the various units into one coordinated whole. Techniques that are not considered to be universal practice are explained, as well as points that have been emphasized by the features of the particular application. The writer discusses the general plan of the system, direct labor standards, cost centers, records of production, indirect expense standards, methods of analysis, the supervision incentive plan, and other features of the system. *Automotive and Aviation Industries*, July 15, 1944, pages 36–38, 40, 42, 114, 116, 118, 120, 122, 9 illus.

Marketing

Here Are Your Markets. Part III, Mountain and Pacific Regions and Conclusion. John Foster, Jr. Third and concluding article in a series reporting the results of a survey to determine what states and regions of the United States present the best customer potential for aircraft distribution. Part III contains an analysis of the market criteria for the Mountain and Pacific regions of the country. As a guide for establishing distributor and dealer areas, it also correlates on a nationwide basis the information offered in all three articles. Logical locations for setting up a national aviation-product sales and service network are named. In addition to several charts and tables showing pertinent data, the article includes a list of factors affecting marketing conditions and a two-page map of the location of potential distribution centers. *Aviation*, July, 1944, pages 118–125, 6 illus.

Materials

"We Save Everything but the Squeal"—Then Stop That! Walter A. Hall. This is an article on the organization, functions, and operating procedures of Lockheed Aircraft Corporation's Conservation Department. It is concerned not only with the methods by which critical materials are conserved but also with the system by which records of waste are obtained at the sources, indicating where corrections need to be made. Comments are made on the specific activities of the four major sections that constitute the department and on their supervisory personnel. The four sections are: the Analysis Section, Material-Handling and Identification Section, the Reclamation Section, and the Disposal Section. A two-page chart illustrates the organizational and functional setup of the Conservation Department. *Wings*, August, 1944, pages 1137–1143, 10 illus.

Medicine

Sodium Amytal Narcosis in Treatment of Operational Fatigue in Combat Aircrews. Major Donald W. Hastings, Capt. Bernard C. Glueck, and Capt. David G. Wright. As applied in the case of air-combat personnel, sodium amytal narcosis is prescribed for the treatment of operational fatigue. It is reported that this therapy resulted in the return of 70 per cent of the patients to full combat status within a period of 3 to 4 weeks. The article includes a description of the symptoms, as well as details about the narcosis treatment that was administered. Specific case histories are outlined. *War Medicine*, June, 1944, pages 368–372.

The Comparative Testing of Aviation Oxygen. Comdr. Chalmers L. Gemmill. It is noted that both mechanical and physiological performance tests must be made before oxygen equipment for aviators may be put into service. The second type of testing is discussed. It is stated that, since there is no ideal oxygen equipment that can be used as a standard, the best that can be done is to set up conditions under which the equipment is to be used and to compare existing oxygen apparatus. Consideration is given to an evaluation of the conditions under which the equipment will be used and to the measurement of the oxygen used under the conditions described. Reference is made to experiments made with ten different types of oxygen equipment at various altitudes. The testing of oxygen masks is discussed. *The Journal of Aviation Medicine*, June, 1944, pages 150, 151.

Thyroid Function and Resistance to Anoxia in the Rat. A. M. Hughes and E. B. Astwood. Experiments were conducted with rats to determine whether thiouracil would increase resistance to anoxia. It was found that the administration of thiouracil to rats for 6 days or longer increased their resistance to the anoxia produced by low barometric pressures, low oxygen tension at atmospheric pressure, or carbon monoxide poisoning. No definite effect was observed on the anoxia produced by cyanide poisoning. The beneficial effects observed could be mediated through a lower total oxygen consumption, a more efficient utilization of available oxygen, or the use of an anaerobic source of energy. The possibility of improving aviators' efficiency at high altitudes by a similar treatment with thiouracil is suggested. *The Journal of Aviation Medicine*, June, 1944, pages 152–157, 196.

Effect of Partial Hepatectomy on General Resistance and Blood Sugar Level in Rats Exposed to Anoxia. F. Gregoire, C. P. Leblond, and E. Robillard. The role of the liver in anoxia was examined by testing the resistance to anoxia in rats deprived of 75 per cent of the liver. It was found that partially hepatectomized animals, especially when young, have a decreased resistance to anoxia. They do not show the degree of glycemia usually found in hyperglycemia but their blood sugar may be decreased to a point where death occurs with hypoglycemia. *The Journal of Aviation Medicine*, June, 1944, pages 158, 159, 181.

Effects of Physical Activity and of Simulated Altitudes on Pulmonary Ventilation, Maximal Inspiratory (Peak) Flow and Pressure in Relation to Oxygen Requirements. Lt. Col. F. G. Hall and Capt. J. W. Wilson. Measurements were made on individuals at rest (sitting) and exercising at four grades of activity, at ground level and at the simulated altitudes of 10,000, 20,000, 30,000, and 40,000 ft. Experiments were carried out on individuals at simulated altitudes as high as 42,000 ft. The method of conducting the experiments is described.

The following conclusions are reached: (1) Pulmonary ventilation is the same for a given degree of activity from ground level to at least 30,000 ft. simulated altitude. (2) Pulmonary ventilation at 40,000 ft. simulated altitude is higher for a given degree of activity than at ground level. The magnitude of this difference increases with degree of activity. (3) The ratio of maximal inspiratory flow to pulmonary ventilation is higher for an individual when resting than when exercising. (4) Relatively heavy exercise (5,400 ft.-lbs. per min.) can be carried with safety by a normal individual using demand oxygen equipment at simulated altitudes at least as high as 30,000 ft. Tables and charts summarize the data obtained. *The Journal of Aviation Medicine*, June, 1944, pages 160–166, 2 illus.

The Analysis of Aviation Accidents. Lt. (j.g.) B. R. Bugelski. A report based on the writer's experience as Recorder of the Aviation Safety Board, Naval Air Training Center, Pensacola. The importance of conducting the training of pilots without unnecessary loss of personnel and planes is emphasized. Some of the basic problems involved in the analysis of aviation

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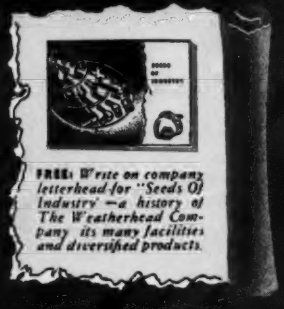

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Flight Lieutenant E. L. HOWEY, D.F.C. *As member of Demon Squadron, took part in several 1,000-bomber raids on Germany*

Flying Officer J. C. MORDEN—*34 operations in Wellington bombers; service in Egypt and Libya*

Flying Officer C. R. FOGAL—*service in Scotland, Gibraltar, North Africa*

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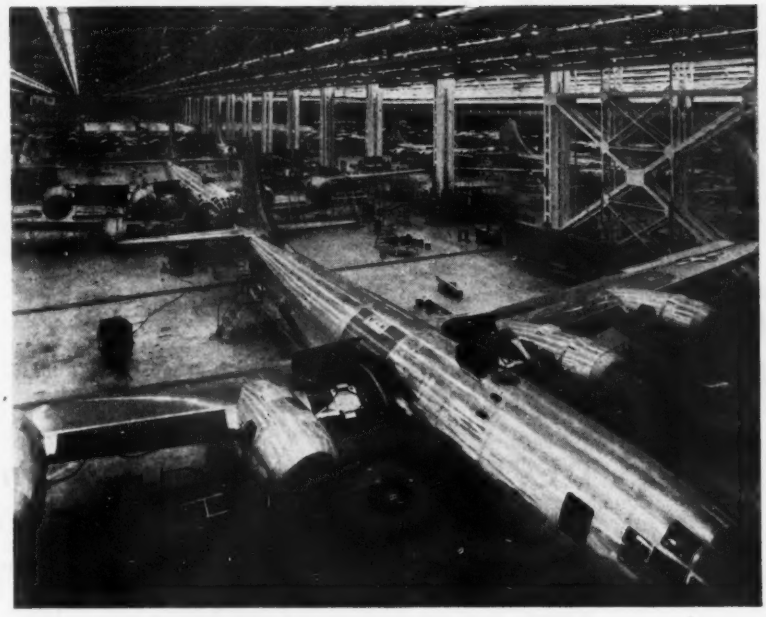
accidents are discussed. It is stated that these problems are largely psychological in nature insofar as causes of human failures or errors are of psychological interest. The writer suggests procedure that he believes will give greater results in the future. He advises that each accident be carefully described in terms of what happened, that the specific causes and types of errors be listed, and that the causes of accidents be studied in terms of practical action. *The Journal of Aviation Medicine*, June, 1944, pages 172–181.

Modern Trends in the Teaching of Naval Aviation Medicine. Capt. Bertram Groesbeck, Jr. The writer takes note of the change in the conception of what the flight surgeon should know and do. He points out that the duties demanded of the flight surgeon of today are somewhat different from those visualized when aviation medicine came into being. It is stated that the selection of pilots from the physical standpoint is still the same important job it has always been but the maintenance of the pilot is an undertaking that has assumed great importance. Present methods of teaching what may be called the basic sciences of aviation—that is, physiology, neuropsychiatry, and ophthalmology—are discussed. It is noted that aeroembolism and "blackout" have assumed increased importance as a result of high-altitude flying. The nature of naval operations has also necessitated inclusion in the course of a study of tropical medicine. *The Journal of Aviation Medicine*, June, 1944, pages 182–185.

A Review of the Activities of the RCAF Medical Service. Group Capt. F. A. L. Mathewson. A brief discussion of current trends and developments in the Royal Canadian Air Force Medical Service. Sections deal with the selection of personnel for aircrew training, the activities of the School of Aviation Medicine, the air evacuation of casualties, aviation medical research in Canada, and the nutritional branch of the medical service. *The Journal of Aviation Medicine*, June, 1944, pages 186–189.

The A.A.F. Altitude Program. Major Herman S. Wigodsky. An article reviewing the development and outlining the objectives of the Army Air Forces' altitude-training program. It is explained that the program is divided into two sections. The first is devoted to general instruction in the physiological problems of flying and in the use of oxygen equipment; the second, to specific instruction in the use of oxygen equipment and other equipment used to combat the physiological effects of flying. Training is carried out by means of training films, lectures, demonstrations, and experiences in the altitude-training chambers. *The Journal of Aviation Medicine*, June, 1944, pages 190–194.

Acute Poliomyelitis Case Transported by Air. Major Victor E. Frazier. A report of the transportation of an acute "polio" case by air. A training plane without oxygen equipment was used. No undesirable effects attributable to change of altitude were noted. It is stated that the case indicates that almost any airplane can be improvised as an ambulance when sufficient emergency dictates. *The Journal of Aviation Medicine*, June, 1944, pages 195, 196.



A Boeing B-29 Superfortress on the final assembly line at the Boeing factory in Wichita, Kan.

Meteorology

Cloud Heights by Solar Observation. Lt. Fred W. Decker. A method is given for making an optical determination of the altitude of the base of middle- and high-altitude clouds. This is based on the lumination of the clouds by the sun or moon when the luminary is below the horizon. Careful observation of the time of sunset and of the time at which the sun's light is cut off from clouds at the observer's zenith, or, on an arc through the zenith and perpendicular to the sun's rays, gives a basis for calculating the altitude angle. An example is worked out, and charts, tables, and formulas are given. The theory is explained. *Bulletin of the American Meteorological Society*, May, 1944, pages 197–201, 4 illus.

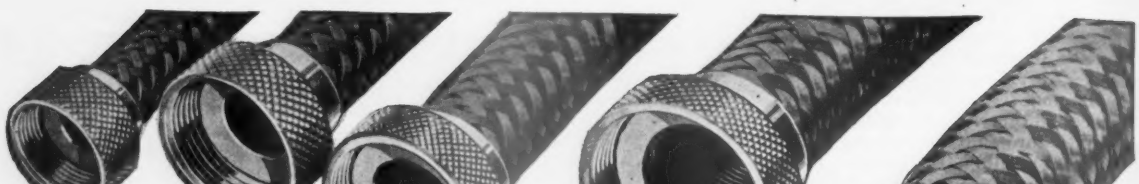
Military Aviation

Aviation Engineers Build, Maintain, and Fight. A. N. Carter. An account is given of how U.S. Aviation Engineer battalions are specializing in airport construction and building bases in many parts of the world. In some cases construction equipment is dismantled and transported to the working site in cargo planes or gliders for reassembly. It is noted that certain battalions, known as Airborne Aviation Engineers, are equipped with bantam tractors and other machines that can be transported by air without disassembly. The training of these troops is described. *Engineering News-Record*, July 27, 1944, pages 64–71, 14 illus.

How Planes Smash Battle Bottleneck. Hal Borland. An account of modern air tactics used for invasion. The writer describes how tactical air forces clear the way for a big drive. It is explained that close teamwork with the ground forces is necessary in these combined operations. Three basic phases of action are outlined. These phases are the achievement of air superiority, the cutting of supply lines and communications, and direct attack by coordinated air and ground forces. *Popular Science*, August, 1944, pages 100–103, 223, 8 illus.

Naval Aviation

The Blitzkrieg Goes to Sea. Vice Adm. John S. McCain. The Deputy Chief of Naval Operations for Air evaluates the importance of carrier-based aviation in carrying out the war against Japan. Reviewing the tactical employment of aircraft carriers in Pacific sea battles since America entered the war, he tells how they have formed the core of striking power and superior mobility required by United States Naval doctrines of offensive warfare. He also indicates how contemplated improvements, as contained in the 45,000-ton class of carriers announced by the United States, will affect future carrier striking power. *Aviation*, July, 1944, pages 112–115, 257, 4 illus.



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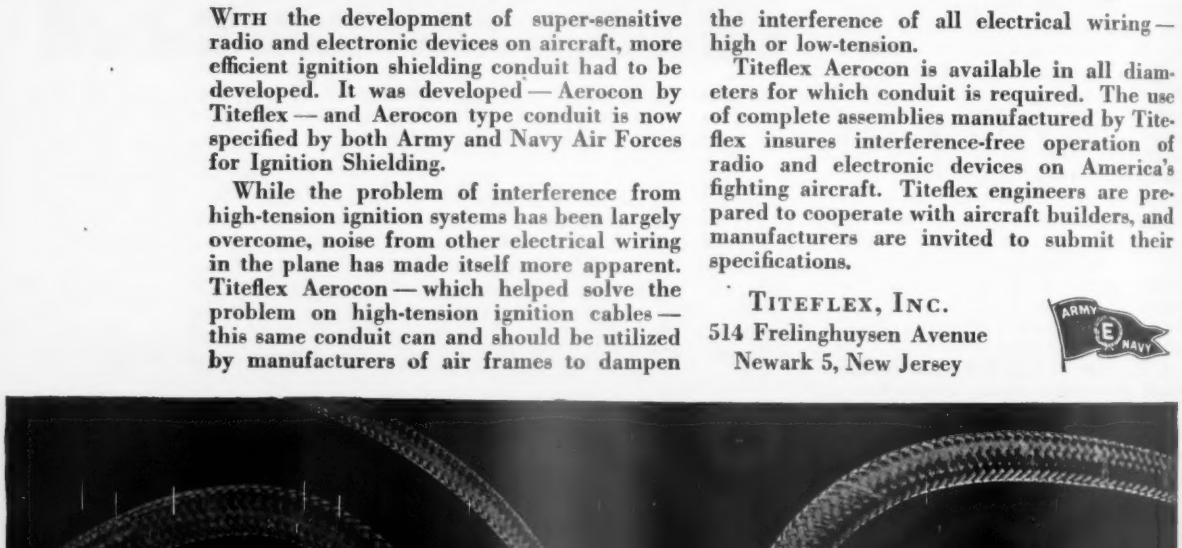


Paints and Coatings

Cleaning Aircraft Parts. A description is given of procedures used for the sandblasting, degreasing, and alkaline cleaning of aircraft parts. The article is based on a survey of aircraft practice conducted by Lockheed Aircraft Corporation. Economical plant installations are also discussed and consideration is given to cleaning and precleaning methods. *The Iron Age*, July 27, 1944, pages 54, 55.

Galvanic Corrosion Control in Aircraft Design and Manufacture. J. F. Mason. A fundamental discussion of the action that takes place during the corrosion of metal is offered for the guidance of aeronautical engineers responsible for the design of air frames. Although the information is applicable particularly to designs for seagoing aircraft, it is also pertinent to practically all types of airplanes. Corrosion is defined as a chemical reaction of a metal with the nonmetallic constituents of its environment. The electrochemical theory of corrosion is explained, and the metals used in aircraft construction are rated in terms of their susceptibility to corrosion. Advice is given concerning the metals that are to be joined in the construction of an airplane so as to avoid, to the greatest possible extent, the galvanic corrosion action that takes place between such metals when they are brought into contact.

It is stated that galvanic corrosion is effectively accomplished by insulating dissimilar metals whenever possible. Reference is made to the basic corrosion specifications promulgated by the Army and the Navy, in which allowance is made for manufacturing procedures and their limitations, based on extensive service experience. Information is given about the processes followed in treating metals to guard against corrosion and about protective paint films used in that connection.

Particular attention is directed to the steps to be taken for the protection of magnesium alloys, because this metal has a great degree of activity. The corrosion reaction is analyzed chemically and comments are made concerning methods of prevention, including conditions under which metals are stored, and measures that can be taken to minimize the causes of corrosion and to offset its effects. Other potential corrosion hazards are mentioned, with examples of problems that afford a cross-sectional view of current practice followed by the corrosion engineer. *Western Flying*, July, 1944, pages 48, 49, 90, 92, 5 illus.

Zinc Plating of Aircraft Structures. A description of a three-in-one zinc-plating operation now used by Consolidated Vultee Aircraft Corporation for plating large aircraft structures. It is stated that the new method is more effective than painting and makes for economy of time and labor. Cleaning, zinc plating, and demagnetization are combined in a one-tank operation. *Industrial Aviation*, July, 1944, pages 20, 22, 23, 72, 7 illus.

Accelerated Sulphuric Acid Anodizing. G. V. Akimoff, N. D. Thomashoff, and M. N. Tukina. Following a summary of the advantages of the sulphuric-acid process for anodizing aluminum-base alloys, an account is given of investigations conducted to determine further possible improvements in the process. Consideration is given to the feasibility of accelerating the process. Sections of the article discuss the elasticity of anodic films, the determination of the metal-solubility rate, the determination of the protective properties of oxide films, and the optimum conditions for an accelerated sulphuric-acid anodizing technique. *Light Metals*, July, 1944, pages 311–319, 11 illus.

Technique for Applying Hot Dopes. A. B. Marsh. This article describes the characteristics of hot dopes and advises on effective application methods for aircraft coatings. It contains information about equipment for heating and controlling the temperatures of the dope, as well as data about two different spraying techniques used: one, where parts are to be sprayed on the same level as the heating units; and the other, where spraying is done at a level above the units. The application of primary, intermediate, and final coats is considered. In discussing the differences between dopes applied at elevated temperatures and conventional dopes, two factors are stressed: (1) The percentage of solids in the hot dopes is approximately twice as great and (2) the viscosity of hot dopes is several times that of cold dopes.

Reporting the weight of film deposited, the writer states that four coats of hot dope will normally result in adequate tautness of the fabric for reasonable periods of operation. The suggested four coats are: one cross coat of primer, preferably bearing a fungicide; one lap coat of clear dope; one lap coat of aluminized clear dope; and one cross coat of pigmented dope. Three precautionary measures are advised: (1) that the ratio of film thickness of pigmented dopes be kept between 25 and 35 per cent of the total film thickness; (2) that sufficient drying interval be allowed between clear dopes and pigmented dopes; and (3) that overheating be avoided. *Aero Digest*, July, 1944, pages 88, 89, 146, 2 illus.

Parachutes

How to Bail Out of the B-25. How to Ditch the B-25. How to Ditch the B-26. Bail-out procedures for the crews of the B-25 and B-26 bombers are reviewed. An outline is given of the duties of each crew member under emergency abandonment conditions. *Air News*, August, 1944, pages 26–29, 14 illus.

Personalities

Australian Aviation's Miracle Man. C. N. Davis. An article on Lawrence James Wackett, Australian aircraft manufacturer and aviation pioneer. Wackett's career is traced from before World War I to his present activities on behalf of Australian aviation and the Allied war effort. He is credited with being the man most responsible for the existence of an Australian-made airplane and an Australian-made engine constructed from Australian materials. Combined with the story of L. J. Wackett is an account of the development of the Wackett Warbler, The Widgeons I and II, the Wirraway, and the Warrigals I and II. *Flying Aces*, August, 1944, pages 18, 19, 44–46, 6 illus.

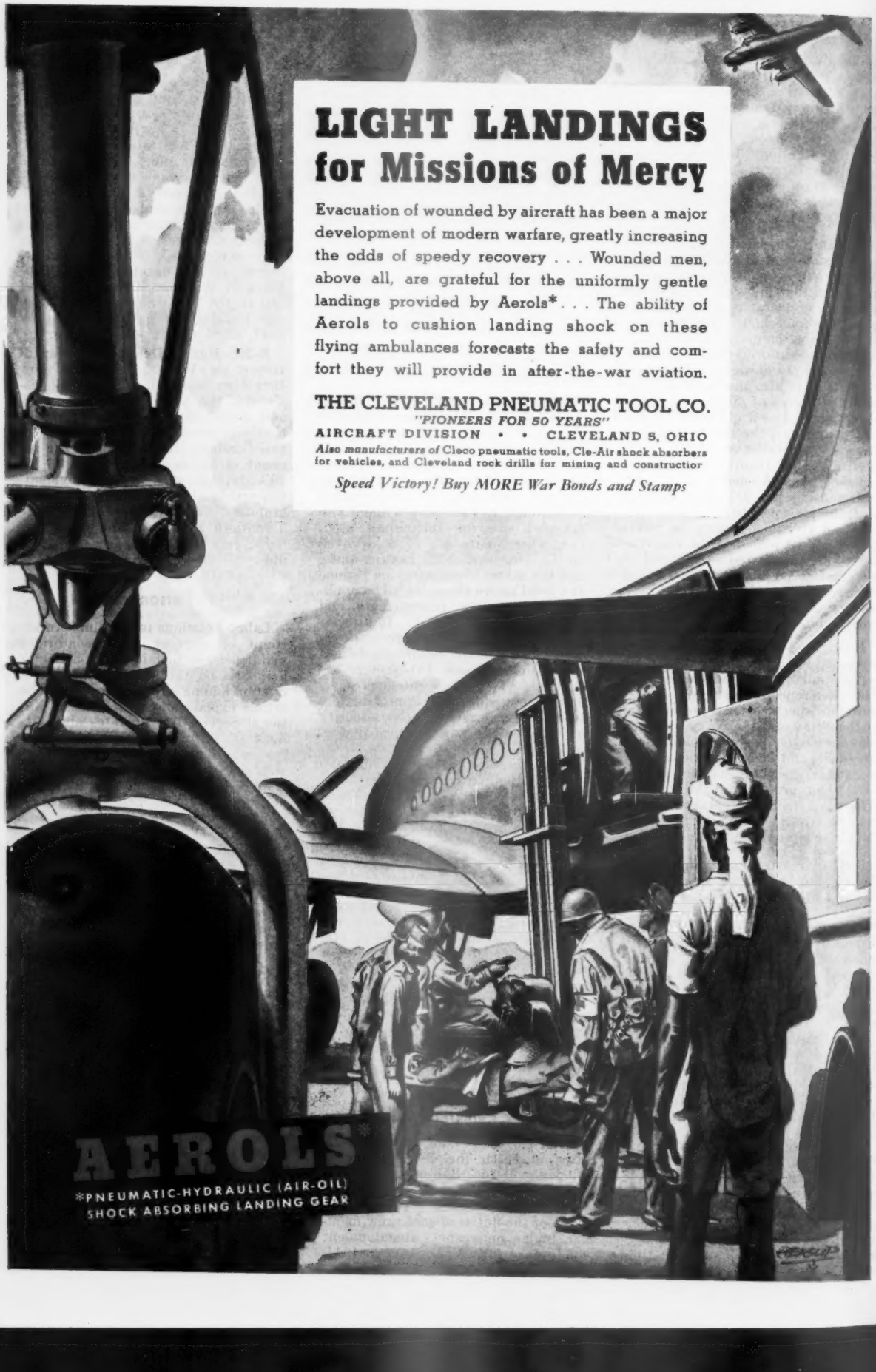
B-29—Rush! Destination—Japan! Robert de Vore. A story of how Brig. Gen. Kenneth Bonner Wolfe assisted in the development of the B-29 and later commanded the groups that pioneered in the combat use of this bomber. In addition to the account of his association with the B-29's development and employment, the article also contains general biographical data on the Chief of the Twentieth Bomber Command. *Collier's*, July 22, 1944, pages 20, 58, 2 illus.

Personnel

Labor Relations in Britain. An account of wartime labor conditions and policies in Britain, with particular emphasis on the stimulation of production among aircraft workers. The article explains how the British National Service Act operates and outlines the airplane-manufacturing industry's structure of wage standards and rates. It also describes various employee services and morale-building methods that help to increase production. Among the services noted are canteen, medical, educational, and recreational services. The review of morale-building efforts includes a report of such activities as personnel counselling, propagandizing among the employees of small companies, publication of house organs, visits of pilots to plants and of workers to the battle front, showing of motion-picture films, use of exhibit vans, and dissemination of information by means of bulletin boards. *Western Flying*, July, 1944, pages 46, 47, 86, 3 illus.

Women's Future in Aviation. Althea "Gerry" Lister. The writer surveys jobs that will be open to women in the commercial aviation field after the war. It is her opinion that the phases of the business in which the majority of women are most likely to forge ahead are Traffic and Public Relations. *Airlanes*, July, 1944, pages 5, 17, 1 illus.

The Ace Business. André Berniere. Stressing the importance of teamwork in air victories, this article explains why, nevertheless, individual mili-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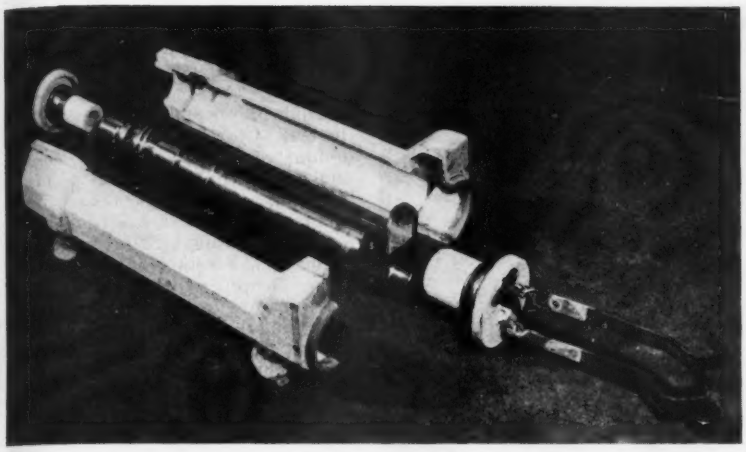

This plastic shield is used for controlling the internal plating of a Curtiss P-40 landing-gear shock strut.

tary and naval fliers are publicized. It reviews the list of top-scoring American aces, tells the kind of airplane each one pilots and the number of enemy planes shot down, and mentions some of the better-known British and Russian aces. Methods of determining "kills" are described. *Flying*, August, 1944, pages 26, 27, 110, 115, 116, 15 illus.

The W.A.A.F. Is Five Years Old. Group Officer C. M. McAlery. On the occasion of its fifth anniversary, the history of the Women's Auxiliary Air Force is reviewed. The brief outline includes notes on the W.A.A.F.'s prewar background, organization, training, trades, director and officers, officer training, living conditions, and recreations. *The Aeroplane*, June 23, 1944, pages 706, 707, 1 illus.

How Woman Flyers Fight Russia's War. Madelin Blitzstein. Exploits of Russia's female military pilots are recorded. The biographies of Marina Roskova, Paulina Ossipenko, and Valentina Grizodubova are briefed, while only the main aviation achievements of other Russian women are noted. Among the latter group are included: E. Bershanskaya, C. Berezhnaya, Vera Lomako, Valeria Khamyakova, Lilya Litvak, Katya Mednikova, Russiko Zhordana, and Ekaterina Mednikova. *Aviation*, July, 1944, pages 116, 117, 255, 257, 3 illus.

Plastics and Plywood

Effect of Environmental Conditions on Mechanical Properties of Organic Plastics. Part II. T. S. Carswell and H. K. Nason. The effect of continuous heating on the mechanical properties of organic plastics is discussed in this concluding installment of a two-part article. Consideration is given to moisture effects, it being noted that the moisture content of the atmosphere, like the temperature, is subject to wide variation. The ways that chemicals may act on plastic materials are listed and discussed. Chemical changes in plastics caused by continuous exposure to light are described. Other sections of the article discuss oxidation, weathering, and the time scale of action of the stresses. *Modern Plastics*, July 1944, pages 125–130, 160, 162, 22 illus.

Load Characteristics of Cellulose Acetate Plastic. Part II. William N. Findley. The second part of an article containing an analysis of the load-resisting properties of cellulose acetate plastics gives consideration to the changes in strength and resistance of this material caused by age, torsion, and moisture. Results of tests on 50 specimens are reviewed, with a detailed description of the experimental test procedure. The preparation involved the immersion of 25 specimens in water for a period of 48 hours, the other 25 being placed in a desiccator over anhydrous calcium chloride for 48 hours. The specimens were then subjected to tests at intervals extending over a period of 1 year. Figures are given in text and charts showing the reaction of the specimens to tests for compression, elongation, stress, moisture content, endurance, and other properties. *Aviation*, July, 1944, pages 164, 165, 263, 264, 5 illus.

Polyfibre—A New Approach to Molding. W. C. Goggin and R. R. Bradshaw. Reference is made to the trend in engineering thinking toward lighter structures, a goal that the war has shown to be desirable. It is stated that Polyfibre, developed by The Dow Chemical Company, provides engineers with a new design material with which to reach unusually low densities. The form of Polyfibre discussed is based on polystyrene and is a fiber ranging in size up to 5 microns in diameter. The characteristics and molding properties of Polyfibre are described. *Modern Plastics*, July, 1944, pages 101–107, 164, 166, 24 illus.; *Plastics and Resins Industry*, July, 1944, pages 3–10, 25–33, 36, 24 illus.

Outside Looking In. A description of how acrylic-plastic models are used by the Ford Motor Company to familiarize students and workers with the intricate mechanisms that go into the B-24 Liberator. Transparent acrylic-plastic blocks are machined to exact specifications for assembly with other plastic or metal parts. The transparency of the plastics allows the interior workings of the mechanisms to be seen in their true perspective. *Modern Plastics*, July, 1944, pages 96, 97, 6 illus.

Plastic Material for Electroplating Shields. Harry W. Tompkins. As developed by the Curtiss-Wright Corporation for various applications, the use of plastics in place of rubber for shields in electroplating is described. Information is given about the thermosetting plastic with acid-resisting qualities which is employed, the technique of bonding metal to the plastic, and the method of embedding metal within the plastic. Among the specific applications detailed are those involving the use of plastic shields in the electroplating of landing-gear shock struts and pistons, in the electroplating of small threaded ends of stud bolts, for the internal plating of forgings, for various kinds of multiple plating, for plating of small parts, and to shield the interiors of fittings against plating. *Aero Digest*, July 15, 1944, pages 109, 110, 112, 130, 10 illus.

Wooden Spar Production. Ronald Grierson. This article traces the design of a type of electrically heated panel used for accelerating the setting of synthetic resin adhesives by heat. It reviews the earlier methods considered possible for this purpose, showing why they were rejected, and describes a device designed and developed by the Northmet Power Company at the request of Vanden Plas, Ltd. The machine and the method are used in the production of spars for the de Havilland Mosquito. It utilizes the principles of surface heating. The construction, consisting of five thicknesses of birch plywood, is described, with information about the power required to generate the temperature that was found to be most suitable for the purpose. The writer relates how the process was developed by experimental work, developing the most serviceable kinds of resistors and electrical conductors, as well as the construction of the specimen test panels. The final panel design and its temperature control are discussed in detail, and tables are given showing figures resulting from the tests by which the heating power, heating time, temperatures, dimensions, resistance, and other factors were worked out accurately. A de-

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scription is also given of the electrical control equipment and the wiring connections employed. *Aircraft Production*, July, 1944, pages 337–344, 8 illus.

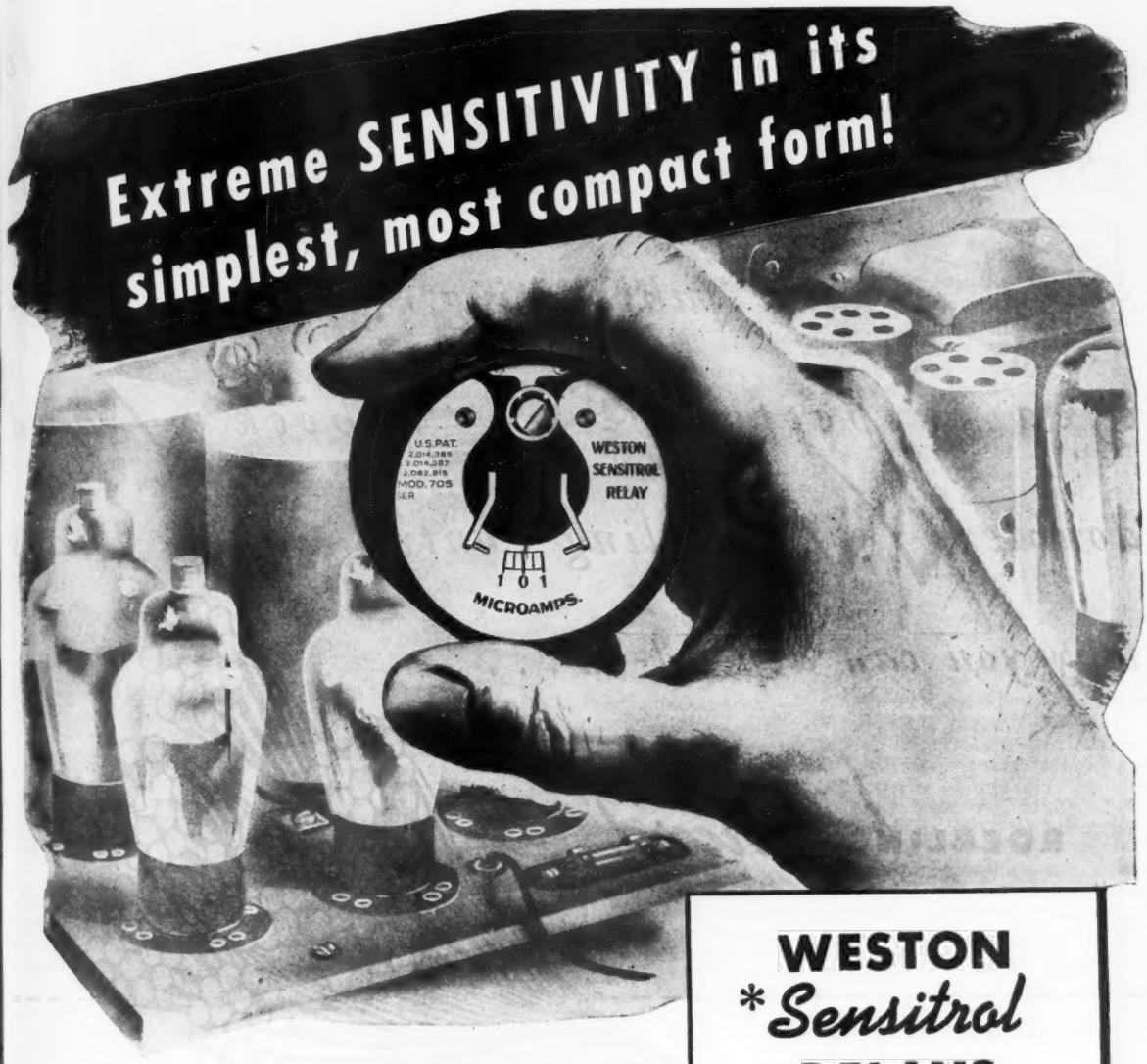
High-, Low- and No-Pressure Laminates. Carrol C. Sachs. Types of laminates available to the designer and fabricator, their methods of fabrication, and the economic design limitations of each are discussed. It is noted that while high-pressure laminating is well established, with many years of application in certain fields, low-pressure and no-pressure laminating are recent industrial developments. Sections of the article refer to the history and developments of laminating processes, the equipment used, materials, impregnation and handling, and cure cycles. *Modern Plastics*, July, 1944, pages 80–82, 172, 174, 7 illus.

The Acetylene Thermoplastics. G. FitzGerald-Lee. The composition and general characteristics of the various plastics belonging to the acetylene group are summarized. The article is intended to provide designers and technicians who are not chemists with practical information about a class of plastic materials which is widely used in airplanes today. *Aircraft Engineering*, June, 1944, page 163.

Postwar Aviation

Three International Policies—Which Will We Have? A. A. Hartsinck. Three separate views advocated by U.S. air transport companies with regard to the manner in which the United States should conduct postwar international air transport operations are reported. The views are those of (1) 17 domestic air lines, who have formed a political-action committee urging open competition; (2) Pan American Airways, which favors a "chosen instrument" policy; and (3) United Air Lines, which has proposed one "U.S. Flag Airline" which would be formed by the cooperation of all lines, with each allocated distinct zones of operation. The group's position is expressed by a five-point program; Pan American's, by statements of its president; and United Air Lines', by recommendations made as a result of surveys conducted by its research groups. *Aviation*, July, 1944, pages 191, 274, 275, 277.

The Post War Airplane. In order to judge more accurately the trends in the design of transport planes, recent developments are reviewed. Ten important aeronautical developments expedited by the war effort are listed. The results of a survey conducted to obtain the point of view of the air lines regarding the fundamentals affecting postwar aviation are outlined. It is stated that the air lines will operate three types of equipment, comprising two types of twin-engined landplanes for feeder service and short trips and four-engined landplanes for transcontinental and transoceanic service. These are described and their



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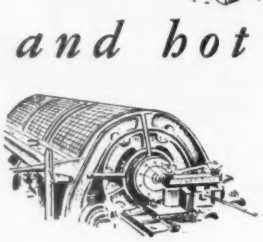
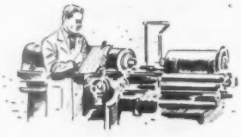
At every stage...from the scrap *to the open hearths* *and hot mills* *and fabricating,*  *keen-eyed inspectors*  *check* ✓ *and double* ✓✓ *Roebling Control Cable. That's why you can depend on...*

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characteristics are tabulated. *Weight Engineering*, Summer, 1944, pages 5, 6, 2 illus.

A Preface to Postwar Planning. Part VI, Cut-Backs and Reconversion. George E. Haddaway. The sixth article in a series discussing the various problems that require solution in the establishment of a sound postwar aviation program for the United States. The writer urges that an immediate plan be set up by the Government for the intelligent and orderly termination of war contracts and reconversion of industry back to peacetime operations. He points out that the aircraft industry is particularly vulnerable to the effects of procrastination and confusion in formulating cutback and reconversion policies. Commending certain developments by Governmental agencies as steps in the right direction, he states that they are, however, meaningless without a master plan dealing in the fundamentals of reconversion as set forth in the Baruch-Hancock report. *Southern Flight*, July, 1944, pages 30, 31, 1 illus.

Private Flying

Wanted—Private Flyers' Amphibian. L. P. Sharples. The Chairman of the A.O.P.A. Executive Committee demonstrates why the promotion of postwar private flying requires the development of an amphibian plane for personal use. He also outlines specifications for such an aircraft. The model he proposes would cost about $2,000, cruise at around 125 m.p.h., and operate at a cost of about one-third more than a similar landplane. *Flying*, August, 1944, pages 66a–66c, 3 illus.

Lengthening the Working Day. Leighton Collins. The thesis of this article is that the peacetime profit possibilities for operators of light planes may be increased by popularizing night flying. Noting that up until the present time flying hours for the majority of private pilots have been limited to the few daylight hours outside of workday schedules, the writer suggests that private fliers can be persuaded to fly in their recreational evening hours through sales appeal and by emphasizing safety features. For this purpose he recommends the following safety features for the airplane: shoulder harnesses, more wing spread, increased strength in seats and belts, slight increases in the strength of the cockpit structures, and better placing of equipment within the cockpit. He also discusses the advantages offered by more adequate lighting equipment for the light planes and the airports from which they operate. *Air Facts*, August, 1944, pages 9–13.

Lightplane Analysis: Cost. James C. Hart. Methods by which the cost of postwar light planes may be lowered are outlined. The factors discussed include the following: production efficiency and short cuts; reduced cost of raw materials through greater use; new ways of reducing the airplane's weight; volume production through sales and the contributing items of utility, safety, and the availability of landing facilities, which will help to promote more sales; standardization of parts; elimination of handwork; volume-purchasing ability on the part of the light-plane manufacturers; and design improvements. *Air Trails*, September, 1944, pages 32, 33, 56, 99, 100, 4 illus.

So You Are Going to Buy a Used Airplane. Joe Chase. Prospective buyers of used airplanes are advised to check, before purchasing, certain items that most commonly require attention in used aircraft. The writer also estimates what the average cost of repair is in each case. Components and accessories recommended for consideration are the propeller, engine, landing gear, tires, fabric, wings, carpet and upholstery, lights and battery box, glass or pyralin, instruments, and radio. It is also suggested that the prospective buyer consult the C.A.A.'s Airworthiness Directive and Airworthiness Bulletins applicable to the particular aircraft. *Air Facts*, August, 1944, pages 60–66.

Lightplane Analysis: Safety. James L. H. Peck. The writer offers his ideas on the type of plane that will be required for postwar private flying and discusses the factors that will affect its acceptance and popularity. Performance, safety, utility, and cost are considered. In tracing the design and engineering trends toward safer light planes, the writer marks the elimination of the airplane's rudder, the use of slots in the leading edge of the wing, the employment of wing flaps, the limiting of elevator travel, the application of tricycle landing gear, and the attainment of greater visibility through the use of plastics. *Air Trails*, September, 1944, pages 36, 37, 68, 72, 74, 3 illus.

Production

Tooling Dock Technique Saves Time, Speeds Accuracy. Leland A. Bryant. Principles of employing master tooling docks in the assembly and checking of jigs and fixtures are explained. In addition, the economies and improvements in production which were derived by Consolidated Vultee Aircraft Corporation through the use of this manufacturing technique are reported. The dock is described as a three-dimensional reproduction of the loft grid lines or planes of the structure. Its dimensional positioning in any of the three geometric planes is accomplished by means of coordinated strip and index templates, generally referred to as dock templates. Since a permanent record of each fixture exists in the dock templates and since the dock is unchanging, it is only necessary to reset the templates in the dock to check, realign, or duplicate the original fixture.

Besides speeding up the entire building process, it is claimed that the use of a master tooling dock enables the attainment of dimensional tolerances seldom before considered practicable. It is stated that the dock facilitates precision duplication of lofting; provides automatic coordination in the making of both fixtures and prototype assemblies; and eliminates the need for transits, surface plates, and height gauges. The master tooling dock technique is credited also with providing a means of precision checking and with speeding the duplication of previously fabricated fixtures. *Aviation*, July, 1944, pages 152–154, 263, 7 illus.; "Master Tooling Dock Facilitates Assembly Fixture Building," Thomas A. Dickinson, *Aero Digest*, July 1, 1944, pages 76–79, 130, 132, 9 illus.

Tolerances and Allowances for Interchangeable Assembly. Frank M. Mallett and Robert H. Lundberg. Interchangeable assembly, as affected by tolerances on the dimensions that locate the mating elements, is considered in relation to the tolerances of the male and female dimensions. Algebraic relationships are derived between least play in attaching elements and tolerances on dimensions locating the attaching elements. Tables are included which give the tolerances that can be used for the common bolt sizes when the attaching elements contain two or more holes. *Product Engineering*, July, 1944, pages 477–481, 7 illus.

Hole Piercing Proves Faster—and Cheaper. Part I. Herbert Chase. In the first of two articles, The Glenn L. Martin Company's methods of utilizing punch-and-die procedures for piercing rivet holes are reviewed. Demonstrating the advantages of the technique over drilling for certain applications, the writer tells how the company combines it with a conveyer belt line system to simplify and facilitate the production of small assemblies. It is pointed out that, in addition to affording savings in tooling expense, piercing procedures substituted for drilling produce holes which, when properly made, have smoother walls, are sized more precisely, yield superior joints, and require no burring. *Aviation*, July, 1944, pages 161–163, 262, 6 illus.

When Loads on the Production Chain Go Up, Don't Let Spares Be the Weak Link! Operating procedures of the Spare Parts Control and Shipping Department of North American Aviation's Texas Division are outlined. The article traces the department's work flow step by step, listing

the functions of each "zone." It is reported that the department's system of material handling and distribution, recommended by the Army, has effected a timesaving of 75 to 90 per cent. *Wings*, August, 1944, pages 1149–1151, 3 illus.

Flow-Line Production of the Douglas Havoc. Thomas H. Brennan. An account of the methods used at the Douglas Santa Monica plant to speed production of the Havoc. The article describes how a mechanized assembly line 7,800 ft. long was compressed into a 700-ft. building. The flow-line production sequence is illustrated by means of a diagram. *Industrial Aviation*, July, 1944, pages 51–54, 56, 57, 68, 10 illus.

Copper Brazing. T. L. Davies. As employed by a British subcontractor, the application of copper brazing to the manufacture of aircraft components is reviewed. Explaining the principles of the process, the writer summarizes its advantages, outlines the method of procedure, and describes the equipment used. He discusses the factors upon which the strength of the brazed parts depends, covering the questions of joint clearances, distortion, and suitable materials. In addition to indicating the part played by gas atmospheres in the successful operation of the process, he also gives specific examples of small aircraft parts that are produced by copper-brazing methods. *Aircraft Production*, July, 1944, pages 346–351, 18 illus.

Making Zinc Alloy Aircraft Forming Dies. Gerald E. Stedman. An account is given of the practical techniques and methods employed by North American Aviation, Inc., to make zinc-alloy blanking and forming dies. It is explained that three types of Kirksite dies are employed: (1) quick-tooling cast Kirksite blanking dies; (2) conventional blanking dies; (3) cast-forming dies for drop-hammer or stretch-press use. Steps in the casting of Kirksite dies are outlined. The production of blanking dies for larger work is described. *Metals and Alloys*, July, 1944, pages 83–88, 6 illus.

Silver Brazing of Tools and Gauges. Frederic L. Woodcock. A discussion of the methods and materials used in the work of tool conservation and repair gives particular information about brazing with silver. The basic principles of a tool-reclamation program are outlined and a detailed description is given of this method of brazing. Its advantages are shown to result from the low working temperature and the free-flowing properties of the metal. The article deals with the application of the method in tool-repair work, the technique for repairing broken tools, the method of heating, and the economies to be achieved in the making of new tools. *Metals and Alloys*, July, 1944, pages 78–82, 9 illus.; "Hints on Brazing," by H. H. Griffith, *The Welding Journal*, July, 1944, pages 624–626, 2 illus.

Photograph Courtesy Aluminum Company of America

Aluminum spinning with an off-center chuck. This chuck is used when the opening in the spun article is small. It has the same contour as the finished spinning, but, being off-center, the tool presses against one side only.

Current Aluminum Alloy Rolling Practice. Comdr. H. F. James. It is noted that the demands for aluminum-alloy sheet for all-metal aircraft have brought about a complete reorientation of the British aluminum-rolling industry. Developments in the aluminum-rolling industry are reviewed, and improvements in rolling practice and rolling machinery are described. Illustrations of rolling mills are shown and a typical layout of a light-metal rolling mill is given. *The Engineer*, June 2, 1944, pages 420–422, 4 illus.

Designing Castings and Forgings. Part II—Die, Pressure, Mold, and Centrifugal Castings. James E. Thompson. The second article in a series on the design of aircraft castings and forgings details the design considerations, processing methods, advantages, and applications of die and centrifugal castings. For die castings, the fundamental design considerations are that: (1) the part be divisible by a longitudinal "parting plane" into two portions, with all surfaces drafted away from each side of this plane; (2) extreme section variations be avoided; (3) all cores avoid backdraft and be located 90° to the parting plane where possible or parallel to the parting plane as a second choice; and (4) the overall dimensions be kept within the maximum capacity of available die-casting equipment. The basic design considerations listed for centrifugal castings are that: (1) the part be capable of reasonable dynamic balance about an axis of rotation; (2) the axis of rotation be a central opening through the casting wherever possible; (3) if the central opening must be less than 1 in. in diameter, it must be spun solid and later machined; (4) the central opening must be truly circular; (5) unrestricted metal flow be provided from center to outside edge; (6) small cores must not be used; and (7) cores must be as close to the axis of rotation as practicable. *Western Flying*, July, 1944, pages 58, 61, 62, 64, 104, 10 illus.

Hawker Typhoon. Part IV: Track Assembly System for the Fuselage: Final Assembly. Wilfred E. Goff. This is the fourth and final installment of an article dealing with the production processes employed by the Gloster Aircraft Company Ltd. in the manufacture of the Hawker Typhoon. Containing an account of the work done on the fuselage assembly track and concluding with a description of the final assembly procedures, it follows three previous installments that have been concerned with wing manufacture, the building of the fuselage, and the assembly of the various components of the tail unit. This installment gives information about the complete installation of the Typhoon's power unit, equipment, hydraulic and electric connections, as effected on an intermittently moving line and according to a fixed time schedule. It also describes how subassemblies and smaller units are brought into the line at points adjacent to the station at which they are fitted by means of subsidiary feeder lines arranged alongside the main track. An outline of the work done at each station is given. *Aircraft Production*, July, 1944, pages 325–331, 17 illus.

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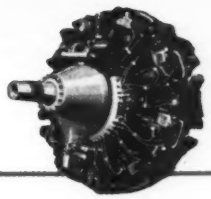

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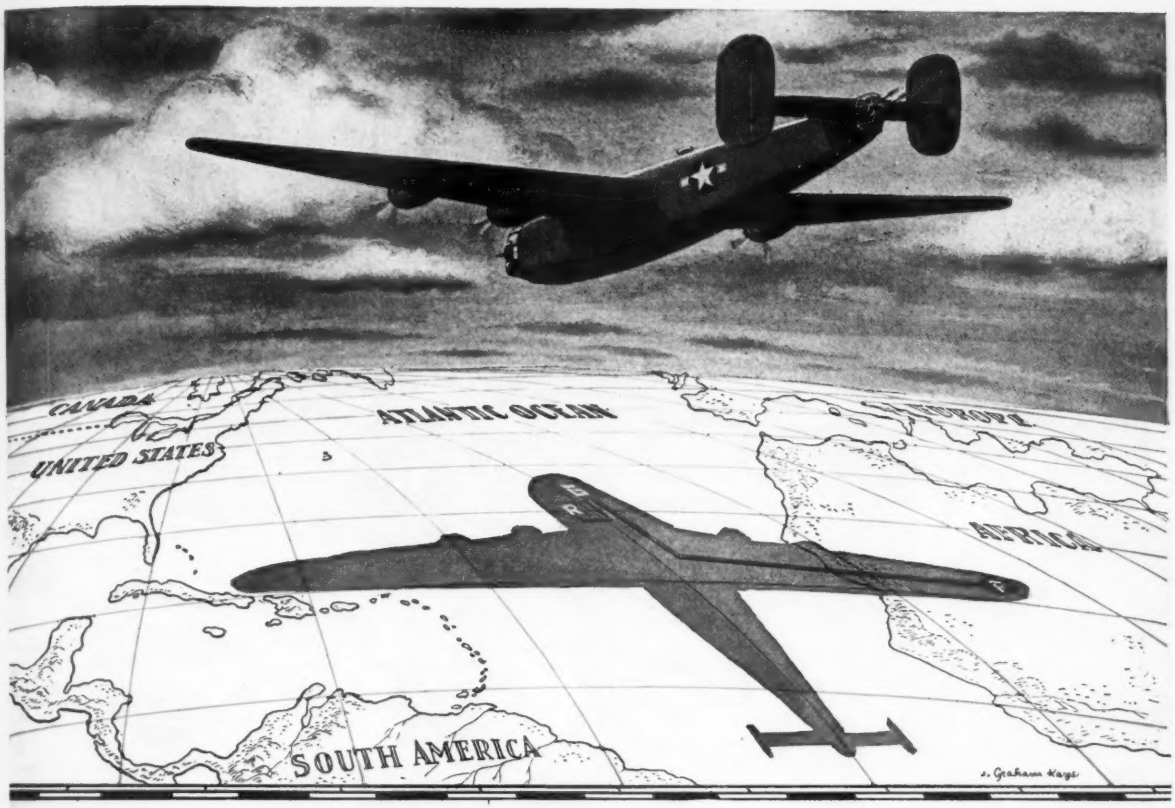

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Hot Forming of Magnesium Alloy Sheets. E. P. Resos. A summary is given of extensive experimental investigations carried out by Consolidated Vultee Aircraft Corporation to obtain data on the possibilities for the use of magnesium alloys in aircraft structures.

Briefly stated, some of the conclusions arrived at are: (1) With proper equipment, magnesium-alloy sheets can be formed at elevated temperature to nearly any shape commonly formed in aluminum alloy. (2) Complete structures can be constructed from magnesium alloy with a considerable saving in weight and a decrease in stiffness if 0-1 alloy extrusions in the heat-treated and aged conditions are used for concentrated members. However, there is some question as to whether the weight-saving in severely formed members is sufficient to balance the extra expense and complications required for hot forming. (3) The use of magnesium alloy for wholly shell-type structures can be recommended in cases where stresses are high enough to justify thick skin and where the radius of curvature is small enough to result in high compressive strength. (4) The use of magnesium alloy for tabs and trailing edge ribs in control surfaces results in great weight-saving. (5) The calculated weight-saving will not be realized entirely because the weight of finishing material required for magnesium alloy is ordinarily greater than that for aluminum alloy. (6) Arc welding is entirely possible, particularly in heavy sheet and bulky fittings. Forming operations, such as drop-hammer forming, hydraulic-press forming, brake bending and dimpling on a number of magnesium alloys of different characteristics and thicknesses are described. *The Iron Age*, July 27, 1944, pages 42–48, 9 illus.

On to Victory! In the first of two special aircraft-production sections, reviews are given of processes and methods developed by numerous aircraft plants for the more efficient production of various airplane components. The section is composed of different articles by executives of various aircraft companies, explaining details of the particular processes and what has been accomplished through their use. The articles are illustrated by photographs and drawings. The titles of the articles are self-explanatory, as follows: "Plastic Punches Facilitate Lockheed Metal-Forming," by George H. Prudden, Lockheed Aircraft Company, Factory "A"; "Boeing Technique in Stretch-Forming Rolled and Extruded Shapes," by Boyd K. Bucey, Boeing Aircraft Company; "Rubber Sheeting Speeds Up Martin Stretching Operations," by Harry F. Vollmer, The Glenn L. Martin Company; "Milling Douglas Integral-Eye Spar Caps from Rolled Billets," by N. A. Lombard and G. R. Gwynne, Douglas Aircraft Company; "Hot-Forming Magnesium Plates at Northrop," by Paul Hawley and Robert L. Gunter, Northrop Aircraft, Inc.; "Thermo-Elastic Forming Airplane Parts from Phenolic Plastics," by W. I. Beach, North American Aviation, Inc.; "Consolidated Vultee Bucking-Bar Development Expedites Production Riveting," by E. P. Myers, Consolidated Vultee Aircraft Corporation; "Expediting Curtiss-Wright Heat-Treating, Anodizing and Plating. . . .," by E. K. Fry, Curtiss-Wright Corporation. *Machinery*, July, 1944, pages 135–198, 92 illus.

Graphic Cost Analyses Guide Selection of Casting Method. Some of the production cost data compiled by the El Segundo engineering department of Douglas Aircraft Company, Inc., are given. The effect of quantity on costs of casting various parts by different methods is shown graphically, and detailed costs for producing the finished part are tabulated. It is shown that by means of such analyses for various quantities of typical designs little time is required to determine the most economical method for the production of any specified quantity of a given part. *Product Engineering*, July, 1944, pages 484–488, 4 illus.

Non-Ferrous Metal for Blanking Tools. Details are given of a method of using a zinc alloy, known as K.M. alloy, for blanking tools. The article has particular reference to light-alloy forming stock for the aircraft industry. It is stated that blanking dies can be manufactured in a fraction of the time previously taken with steel tools. Because of the cheapness with which these tools can be manufactured in the blank and pierce form, drill jigs are unnecessary, which means a saving in the number of tools required per component. It is explained that the construction of these blanking dies is such that their weight is considerably less than those of the older type, resulting in easier handling for storage and setting purposes. The new alloy used in these tools can be recovered by remelting after the tools are no longer required, and the metal can be used for casting new tools. *Sheet Metal Industries*, June, 1944, pages 1019–1035, 23 illus.

Prefill Injection System for Die Castings. Fred C. Ziesenheim. How the scope of die-casting is being broadened by the introduction of the prefill injection method of producing nonferrous castings. It is explained that this method makes possible the die-casting of larger and heavier parts from aluminum, magnesium, and copper alloys, which in the past have been made by sand or permanent mold casting. The vertical elimination of porosity results in castings of greater strength and utility. Die-casting machines of the prefill injection type are described, and aircraft parts made by the process are illustrated. *The Iron Age*, July 13, 1944, pages 66–69, 130, 6 illus.

Methods for Forming Sheet Aluminum. Part III. This is the concluding installment of a three-part article in which the techniques of sheet-metal forming are described. Part III details the blanking and piercing processes by which sections are cut from the sheet-metal stock for use in subsequent forming operations. Various methods of blanking are noted, including blanking by power-driven presses (which is stated to be the most common method used for aluminum), blanking with shears, blanking by use of routing equipment, and the Guerin method of blanking. In describing the piercing operations, the article differentiates between piercing and perforating. Recommendations with regard to correct procedures of blanking and piercing are given, in addition to data on the type of equipment that is required. Two tables supplement the article: one includes a list of punch and die clearances; the other shows suggested scrap allowances on the sides and between blanks for various gauges and diameters. *Aviation*, July, 1944, pages 166, 167, 264, 267, 6 illus.

Aircraft Engine Forging Operations. William V. Humphrey. A description of how the Dodge Chicago plant of the Chrysler Corporation is now producing all its own forgings to speed the production of 18-cylinder Wright aircraft engines for the Superfortress. The sequence of operations in the forging of the three crankcase sections is described. *Industrial Aviation*, July, 1944, pages 58, 59, 5 illus.

Propellers

Wooden Blades. L. G. Fairhurst. This article deals with the weight-savings that can be made in the propellers of postwar civil transport planes through the use of compressed wooden blades instead of metal ones. Surveying design requirements for propellers of postwar air liners, the writer indicates the various advantages of the wooden blade. Among these he stresses the weight-saving feature for optimum economical operation, particularly where heavier types of aircraft are concerned. Performance, operation, and maintenance features of the wooden blade are also noted.

The article includes a brief description of wooden-blade construction. In addition, it offers appraisals of specific savings in weight and money that can be obtained by using wooden-blade propellers on the following postwar civil aircraft types: (1) twin-engined feeder-line plane, (2) four-engined air liner, and (3) superairliner or seaplane. *Flight*, June 29, 1944, pages 697, 698, 4 illus.

Service and Inspection of Electric Propellers. Edward J. Clement. Following a brief description of the constructional features of electric propellers, some of the steps in the field inspection and servicing of a typical model are listed. The information is given in the form of illustrated charts classified under the heading "What to Check," with corresponding lines giving topical directions under the head-

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flight test program

actual

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ing "What to Do." The illustrations give close-up views of the various operations. *Aviation Maintenance*, July, 1944, pages 53–58, 18 illus.

Heat Treating Hollow Steel Propeller Blades. A supplement to a previous article gives additional information about the furnaces used for heat-treating Curtiss-Wright propellers and propeller hubs. Illustrations of the furnaces and heat-treating operations are shown. *Steel Processing*, July, 1944, pages 445–447, 5 illus.

Radio

Electronics—in a Hurry. Lt. S. L. Reiches. The functions and working methods of the Signal Corps' 1st Very High Frequency and Installation and Maintenance Unit are described. Attached to the Air Service Command and based at Robins Field, Ga., the 1st I. & M. sends out trained teams of radio and electronic specialists to install and service apparatus that is beyond the scope of lower-echelon personnel in various theaters of operation. They also teach the personnel of these operational theaters how to install and maintain the radio and electronics equipment. *Air Tech*, August, 1944, pages 52, 56, 1 illus.

Antenna Installations for Civil Aircraft. William P. Lear. In the second series of articles on aircraft radio, the selection and installation of the antenna system are discussed. The writer describes the "whip," "balanced-T," and "L" types of antenna for the radio-range receiver, the "V" type for transmission, and the "reel" antenna for either transmission or reception. He advises on the requirements that each type fulfills, the features of each, and the most advantageous methods of installing them. *Air Pilot and Technician*, July, 1944, pages 24–27, 9 illus.

Reaction Propulsion

Thrust Augmentors for Rockets. Cedric Giles. Consideration is given to the use of auxiliary air-inducing nozzle devices for increasing the velocity and range of rockets. It is stated that thrust augmentation may be applied to meteorologic rockets, rocket-gun missiles, and atmospheric-transportation rockets and may also be feasible for jet-propelled planes. The writer discusses types of augmentation, launching devices, ejector tubes, multiple-nozzle thrust augmenters, and research developments. *Astronautics*, June, 1944, pages 4–11, 6 illus.

Rocket Armament and Propulsion. Parts I and II. A two-part article contains a brief review of the history of rocket-propelled armament as applied to aircraft, tracing the developments from its adaptation during the first World War by a French naval officer. The first British use of the French type of rocket is stated to have been in 1916 during the Somme offensive when Nieuport Scout planes equipped with them attacked four German balloons. Other employments of the rocket projectiles are described, including Russian and British uses and the equipment of American combat aircraft with rocket bombs.

The Sikorsky R-5 helicopter, powered by a 450-hp. Pratt & Whitney Wasp Jr. engine.

The second part of the article explains the principle of reaction propulsion as applied to projectiles and for propulsion of aircraft, including the so-called "robot bomb." *The Aeroplane Spotter*, June 15, 1944, page 136, 3 illus.; June 29, 1944, page 148, 4 illus.

German "Buzz Bomb" Blasts Britain. William A. Hunter. The Craignon Long Distance Aerial Torpedo Bomb, a robot bomb conceived by a Canadian aeronautical engineer in 1932, is described in detail. The technical data offered in the article constitute a digest of the information contained in the original specifications accompanying the patent. Among the features of this flying bomb to which attention is called are its engine power, droppable wings, control compartment, wing triggers, empennage, tail compartment, and hydraulic stability control. Methods of range finding and launching are outlined, specifications are listed, and production costs are estimated. *Commercial Aviation*, July, 1944, pages 36–40, 42, 44, 46, 6 illus.

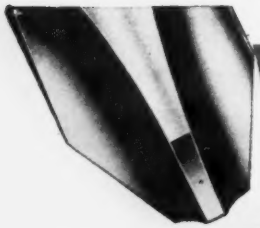
The Rocketor's Primer. A list of fundamental formulas and symbols applying to the liquid-fueled rocket engine, with their definitions. An example is worked out for a hypothetical engine, showing the accepted method of calculating the efficiency. *Astronautics*, June, 1944, page 13.

Reconversion

Embry-Riddle's Maintenance Facilities Converting to Serve Aviation at Large. Arthur W. D. Harris. A description of the organization and activities of a privately owned aviation training school that is operating four flying fields and a seaplane base in the Miami area; serving as a contractor for the U.S. Army Air Forces, the Royal Air Force, the U.S. State Department, training Latin-American students to become aircraft technicians, and training under the Civilian Pilot Training Program. A chart shows the organization of the company and its facilities for serving military, commercial, and private aviation. One section of the article is devoted to a description of the engine overhaul department and how it is being expanded. Another section tells about the instrument department, which is equipped to overhaul, repair, and refinish, on a production-line basis, most types of aircraft instruments. *Aviation Maintenance*, July, 1944, pages 39–45, 174, 176, 178, 19 illus.

Rotating Wing Aircraft

Direct-Lift Aircraft. Igor I. Sikorsky. The development of the direct-lift aircraft, which does not require an air strip for taking off and landing, is briefly discussed. It is noted that while the fundamental principle of operation is simple, the conversion of the principle into practice has involved the correct solution of many problems, some so difficult that doubts were expressed that a practical helicopter would ever become a reality. Some of the characteristics of the modern helicopter are described. Reference is made to the use of inflated rubber bags as a landing device. It is stated that the speed of the helicopter will be relatively low for a long time to come, probably not exceeding 120 to 140 m.p.h. Loads also will not be so great as with airplanes. It is apparent, however, that the characteristics of the helicopter will qualify it to fill a large void in present transportation needs. Several recent instances of the use of helicopters in rescue work and for medical emergencies are included. *Mechanical Engineering*, August, 1944, pages 509, 510, 4 illus.



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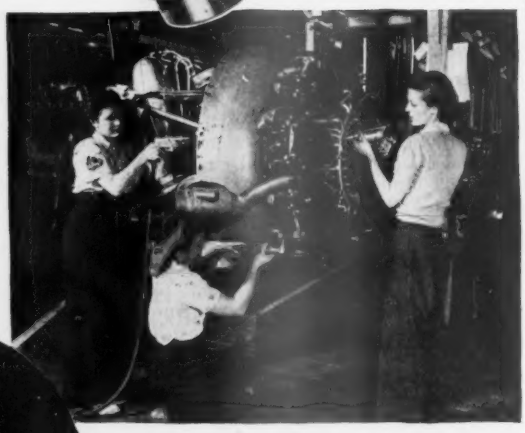
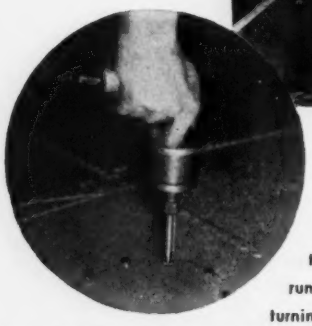
The illustration below shows a specific instance of the proficiency in power driving that can be attained by women workers. At the Consolidated Vultee Aircraft Corporation in some departments power tools replace hand-driven screw drivers and wrenches commonly used when men were employed. This production - boosting operation has been made possible by the adoption of recessed head screws. By this modern fastening practice, experienced workers can cut fastening time up to 50% and more.





When Speed Nuts are used with HOLTITE Sheet Metal Screws in place of machine screws, another saving in production time is effected, as the small tapered point permits a quicker start when nuts are run on. The smooth threads with faster lead reduce turning time and provide a tighter lock to defy vibration.

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Stress Analysis

Applying Creep Data in Design. Part I, Methods of Interpretation. Joseph Marin. Part I of a continued article discussing the factors influencing creep, the methods of interpretation of creep tests, and the design of members subject to creep. This installment deals with methods of interpretation and the creep properties of different metals and plastics. The importance of allowing for creep, particularly in certain machine elements operating at high temperatures, such as turbine parts, is emphasized.

The usual tension creep test in which a tension specimen is subjected to constant stress and temperature is described. Methods that have been proposed for the extrapolation of creep-test data are discussed. These include the log-log method, the log method, and Soderberg's method. Consideration is given to design stress variations. Different creep-testing machines are illustrated. *Machine Design*, July, 1944, pages 123–126, 182, 10 illus.

Das Torsionsproblem für Stäbe von kreisabschnittförmigem Querschnitt (The Problem of Torsion for Bars Which Have a Segment-Shaped Section). A. Weigand. It is noted that the problem of torsion of prismatic bars leads to the problem of marginal values. A problem of this kind with reference to the segment-shaped section is solved by approximation. Torsion and expansion measurements show that the solution by approximation is sufficiently exact to conform with actual values. *Luftfahrtforschung*, February 8, 1944, pages 333–340, 8 illus.

Strains in Riveted Joints. J. A. Chamberlin. The results are reported of a series of tests to determine the effects of oversized rivet holes and stressed rivets upon the strength of joints. Tests for the first condition lead to the conclusion that, filled by the bucking of the rivets, oversized holes do not reduce the strength of a rivet joint, provided that (1) the effect of reduction in area of the sheet does not weaken the joint, and (2) the oversized holes are not more than 50 per cent larger than the original, if they are both the same size, or 25 per cent if they are of different sizes. From tests for the second condition it is concluded that there is no cause for alarm should a rivet show slight wrinkling of the paint or even a trace of white metal around the edge of the head. The results of pulling several series of test pieces of different gauges until the rivets failed are tabulated. *Aero Digest*, July 1, 1944, pages 101, 102, 2 illus.

Bursting Tests on Notched Alloy Steel Tubing. G. Sachs and J. D. Lubahn. In these tests it was found that heat-treated alloy-steel tubing subjected simultaneously to circumferential and longitudinal tension showed slightly higher tensile strengths and much lower ductility

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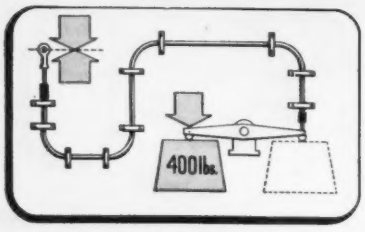
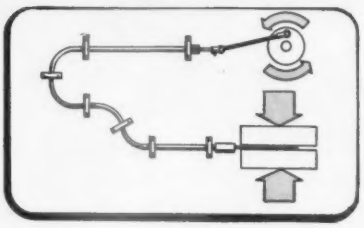
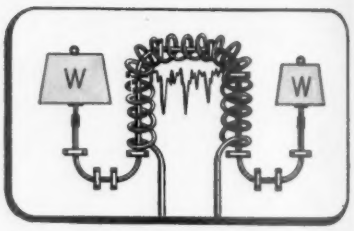
of Army Air Force Winterization acceptance for operation in extreme temperatures is the Simmonds-Corsey Push-Pull Control. Comprehensive tests with temperatures as low as minus 72°F. and as high as 160°F. prove efficient operation under wide variety of conditions.



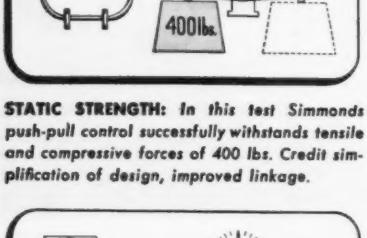
STATIC STRENGTH: *In this test Simmonds push-pull control successfully withstands tensile and compressive forces of 400 lbs. Credit simplification of design, improved linkage.*



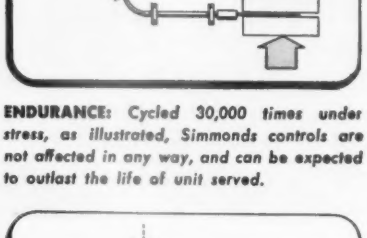
ENDURANCE: *Cycled 30,000 times under stress, as illustrated, Simmonds controls are not affected in any way, and can be expected to outlast the life of unit served.*



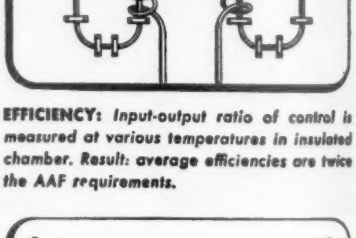
EFFICIENCY: *Input-output ratio of control is measured at various temperatures in insulated chamber. Result: average efficiencies are twice the AAF requirements.*



PRECISION CONTROL: *Motion between tension and compression is negligible. Before endurance test: average—.046"; after—.082". Simmonds are precision-built controls.*



DEFORMATION: *AAF specifications call for loads ranging from 10 to 50 lbs. Allowable average deformation is .140". Simmonds controls average only .083".*



CORROSION: *Simmonds controls meet AAF specifications for corrosion resistance with standard cadmium plated or anodized surfaces. Tube ends are rubber sealed.*

INQUIRIES concerning War Contracts or Post-War problems involving push-pull control equipment are invited. Our service engineers will furnish you gladly with analyses and recommendations. Telephone or write to your nearest Simmonds office.

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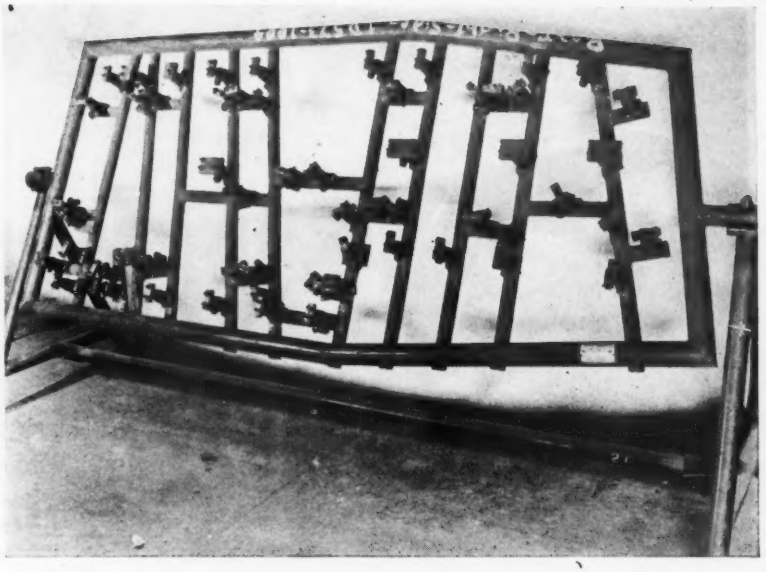
values in the circumferential direction than rod tested in tension. A sharp longitudinal notch on the outside surface of the tubing was found to be the most severe embrittling agent observed so far, in that steels with a strength level as low as 150,000 lbs. per sq.in. had a notch strength less than the strength of unnotched tubing.

It is stated that such a single notch did not have the strength-increasing effect that was expected for sufficiently ductile conditions. A double notch (on both inside and outside surfaces), however, did produce such a strength-increasing effect, but the increased lateral stress that is responsible for such an effect did not cause any greater embrittlement than a single notch. The conditions of fiber direction are usually considered to be less favorable in tubular specimens machined from solid rod and subjected to internal pressure than for drawn tubing. However, no such effect of fiber direction was observed in tests on notched tubes machined from rod. *The Welding Journal*, July, 1944, pages 351-s–356-s, 9 illus.



A typical application of standard locators to a tubular side-frame subassembly fixture, showing arc-weld type of construction for the basic frame and a typical trunnion mounting permitting full down-hand welding.

Testing

Fatigue Tests of Parts Made Basis for Design. H. O. Boyvey. A discussion of methods of fatigue-testing shows how these methods provide design criteria to guard against failure of aircraft parts in service. It is shown that failures have occurred in certain aircraft parts even when designed to carry a static load 50 per cent greater than the maximum expected. The article relates how fatigue limits, based on performance of representative parts, and arbitrary estimates of fatigue loads establish safe values for design. A detailed description is given of the apparatus devised for making these fatigue tests and how it is used in establishing the limits of stress for which aircraft parts should be built. The work is based primarily on data obtained through maintenance reports, but the lack of complete information of this sort makes it necessary to establish arbitrary standards from the best available estimates. The article refers to parts made of the usual aircraft metals and concludes with a discussion of testing methods for aircraft plywood. *Product Engineering*, July, 1944, pages 444–448, 17 illus.

Testing Equipment

A Climatic Test Chamber for Testing Electrical Aircraft Equipment. R. H. W. Burkett and H. K. Henisch. The construction of a test chamber for simulating a variety of climatic conditions is described. It is explained that the temperature range is from −30°C. to +73°C. and relative humidity can be regulated at all temperatures above 0°C. Apparatus under test can be covered with a film of ice by a sudden humidification of the air when the apparatus is cold. The operation is completely automatic and controlled by an electro-pneumatic switching system. A short outline is given of possible failures of electrical apparatus caused by atmospheric conditions. A typical cycle of operations is also described. *Journal of Scientific Instruments*, June, 1944, pages 106, 107, 3 illus.

Application and Use of Electronic Measuring Devices. H. Johnston. An article on the application of electronic tubes to measurement problems connected with the design and building of equipment. Subjects discussed include the measurement of sound in the manufacture of quiet-operating apparatus; vibration measurement, including the measurement of strain and vibration in aircraft parts and structures; the measurement of speed variations; and electronic devices for various testing purposes. *Industrial Aviation*, July, 1944, pages 47, 48, 50, 7 illus.

Tools and Equipment

Face Milling. Descriptions are given of two types of negative-rake cutters manufactured by Samuel Osborn & Company, Ltd. One is the Negraika facing cutter, intended for producing fine surface finishes at high speeds. This cutter has a carbon-steel body of special design into the rim of which are brazed sintered carbide teeth, set to give negative angles on the helix and face. The use of this tool is claimed to obviate the necessity for planing, milling, grinding, and lapping operations and to require only finish-lapping in their place.

The second type of cutter is designed for heavy-metal removal. It comprises a sturdy steel body, with circular discs or blades that are spigoted and held in the body by an Allen screw and a locking screw. The teeth are interchangeable and are set at a negative angle to the center with a slight positive rake on each tooth. *Aircraft Production*, July, 1944, page 333, 2 illus.

Designing Airframe Assembly Tools. Part II. A. S. Turner. The second section of a two-part article suggests that jig design should provide for the most efficient operation by workers, avoiding fatiguing motions, unnatural postures, excessive lifting or other physical strain, and the possibility of accident. Fast-acting clamps, work benches, stock bins, and storage racks should be incorporated in the design to get the maximum benefit in output and time-saving. Attention should also be given to the ease with which the jig can be adjusted and repaired so that it can be kept in practically continuous use. Other factors are stability, mobility, and "manufacturability," the latter term being explained as the characteristics of the design that affect the ease and economy with which the jig can be built. Methods for fitting and fastening its parts together are recommended. The important factors of the cost of building and maintaining the jig are discussed. *Industrial Aviation*, July, 1944, pages 41–46, 7 illus.

Three-Dimensional Lofting as an Aid in Jig Construction. John W. Clerke. The solution is given of a tooling problem that was solved when the Glidden Buick Corporation, a New York automobile distributing organization, undertook the production within a limited time of a complicated tubular-steel frame used in aircraft construction. The part described is the forward steel truss, used for sustaining concentrated loads

MARTIN MARS SLASHES TON-MILE COSTS

AIRCRAFT operating costs, low enough to permit comparison with surface costs in some fields, are now within sight thanks to the 72-ton Martin Mars. World's most efficient airplane, the Mars already shows an operating cost of less than 15 cents per ton-mile, according to Glenn L. Martin, president and founder of the company which bears his name.

Moreover, Mr. Martin declares, the twenty new 82-ton Mars transports now being built for the U. S. Navy will have an operating cost of 10 cents per ton-mile at 80% cargo capacity; while a ton-mile operating cost of 7 cents is in sight.

For example, in the shipment of deep-frozen foods, Mars transports, dispensing with mechanical refrigeration by climbing to 25,000 feet and sub-zero temperatures, will operate at amazingly low ton-mile costs at speeds upwards of 200 miles per hour. And this is only one of many new fields the Mars has opened to aviation. To reach the world of tomorrow, ship by Martin Mars!

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in the fuselage of a twin-engined, wood-construction bomber and gunnery trainer. The structure is composed of square and round tubing of various sizes, fastened together by welding. The truss is described and the three basic steps in the construction program are explained in detail. The first step was dividing the job into subassemblies that could be economically fabricated; the second step was designing the special jigs and fixtures needed; and the third was the manufacture of the tools as designed. With the aid of illustrations, the construction and application of the jigs and fixtures are explained, as well as the steps taken to allow for shrinkage and distortion during the welding process. The entire program was prepared and put in operation within the required period of 60 days. *The Welding Journal*, July, 1944, pages 626–629, 9 illus.

Air Line Maintenance and Repair. Several examples of equipment developed by British Overseas Airways for the maintenance of aircraft are surveyed. The rigs and machines described include: a universal instrument stand to test instruments and units not included with the engines; a propeller-blade twisting machine for preformed shapes; a test bed for ensuring the correct functioning of the propeller before service; an autopilot, a horizon, and gyro-rudder test rig; and a universal engine stand for building in-line or radial engines. In addition, other examples of maintenance equipment evolved by the same company are depicted. These are a universal bulb thermometer test rig, universal engine and power-egg sling, universal ground-testing rig, dismountable rostrum, plug-overhaul test bench, and universal testing machine for obtaining the brake horsepower of auxiliary motors or starting motors. *The Aeroplane*, June 2, 1944, pages 621–623, 10 illus.

Training

Mental Emergencies. Lt. Malcolm Cagle. Procedures are outlined for drilling aircraft crews to meet certain basic flight emergencies. The emergencies are fire, falling fuel pressure, falling oil pressure, overheating engine, water landing, crash landing, and collision. *Air Facts*, August, 1944, pages 54–58.

"Swift and Watchful." The course of training at an R.A.F. School of Radio is described. As outlined, the course is divided into two sections. During the first half, the student receives a thorough elementary training in electricity and magnetism, valve theory and circuits, and Morse code (including procedure), as well as instruction on how to build a receiver and a transmitter. The second half of his training comprises advanced theory, practical work on standard installations, direction-finding procedure, and practice during actual flight. Among additional subjects studied are armament, navigation, meteorology, and aircraft recognition. *The Aeroplane*, June 9, 1944, pages 645–647, 12 illus.

Convair Classes "Broaden the Specialists." H. L. Wheeler. This article contains information about the classes that Consolidated Vultee Aircraft Corporation conducts for its engineers. The classes are intended to keep men who specialize in the engineering of one particular part of the aircraft up to date on developments in the overall technical functions of the other parts of the plane. In addition to broadening the personnel's acquaintance with general progress in aircraft engineering, the school is utilized also to introduce specific new design methods and to impart knowledge regarding new materials, equipment, and processes.

The list of 55 subjects discussed at the company's Fort Worth division includes such subjects as cockpit arrangements, general hydraulics, levered suspension and caterpillar landing gears, propeller controls, soundproofing, anti-icing, and "blind-landing" equipment. *Aviation*, July, 1944, page 169, 1 illus.

Contract Schools Look to the Future. Glenn E. Carter. This is an appeal for the Government to institute an aviation-training program that will utilize the facilities of contract flying schools and preserve them until such time when they will be able to return to free enterprise. Reviewing the role played by these schools during the beginning of the war, the writer indicates that the preservation of these schools, their equipment, and training staffs is necessary for national safety and the development of commercial aviation after the war. It is suggested that the training courses provided for in the "GI Bill of Rights" present one efficient means of utilizing A.T.S. facilities. *Southern Flight*, July, 1944, pages 28, 29, 46, 5 illus.

Classroom Navigation. John C. Ross. A description of the oversized instruments that are used for classroom training of A.A.F. navigators. Among the instruction devices noted are "blow-ups" of the standard Army-Navy E-6B computer, the Weems plotter, the pressure-correction demonstrator, the aperiodic compass, and the drift meter. *Flying*, August, 1944, pages 50, 51, 152, 156, 4 illus.

A Few Tough Nuts and How They Were Cracked. Lt. (j.g.) Robert W. Duncan. Some observations about the manner of giving verbal instructions to flight-training students. From his own experiences as a flight instructor, the writer offers some helpful suggestions on how to build up confidence in a student while teaching him specific maneuvers. The use of positive instructions and the avoidance of negative ones is recommended. *Air Facts*, August, 1944, pages 33–44.

Instrument Ratings for Civilian Pilots. A brief outline of some of the fundamentals in a course of instrument flight training. The article indicates the knowledge that is required for an instrument rating and discusses some of the problems encountered in learning to fly "blind." *Air Pilot and Technician*, July, 1944, pages 14–16, 3 illus.

'Varsity Short Courses. Geoffrey Waller. An account of the Air-Crew University Short Course given to qualified Royal Air Force air-crew candidates at various universities in the British Isles. This syllabus provides for a university course in either the arts or sciences, in addition to covering the entire Initial Training Wing program. The article describes the studies that are available at present under this plan, the status of the cadets at the university and when they graduate, and the conditions under which they live and study as undergraduates. *The Aeroplane*, June 30, 1944, page 734.

Warfare

The Tactical Use of Numbers. By A. F. In this discussion of the kind of military aircraft formation that provides the best use of numbers in attack, the writer describes the cross-over technique. He also examines the lattice type of formation as the basis for convergent attack. The maneuvers executed are analyzed in detail, with comments on the particular flight characteristics of the Sopwith Camel and the Spitfire. Diagrams illustrate the formations discussed and clarify the principles upon which the formations are based. *Aeronautics*, July, 1944, pages 46–49, 9 illus.

Air Reconnaissance. Michael Goodwin. This article deals with some of the principles and problems of air reconnaissance. It examines the advantages and disadvantages of air observation at various altitudes, outlines bases of visual recognition, and reviews standard features of indentification. Differentiating between day and night operations, it also discusses the question of the angle at which reconnaissance is likely to be most efficient. *The Aeroplane*, June 2, 1944, pages 616–618, 8 illus.

Attack and Victory. Photographs and diagrams depict the course of an actual combat between a Spitfire and a Focke-Wulf 190. The photographs are taken from a motion-picture film recording the complete course of the fight from the time the two fighters made contact to the destruction of the Focke-Wulf. The text and diagrams explain the maneuvers executed by the two pilots and the character of the gunfire. *Aeronautics*, July, 1944, pages 42, 43, 12 illus.

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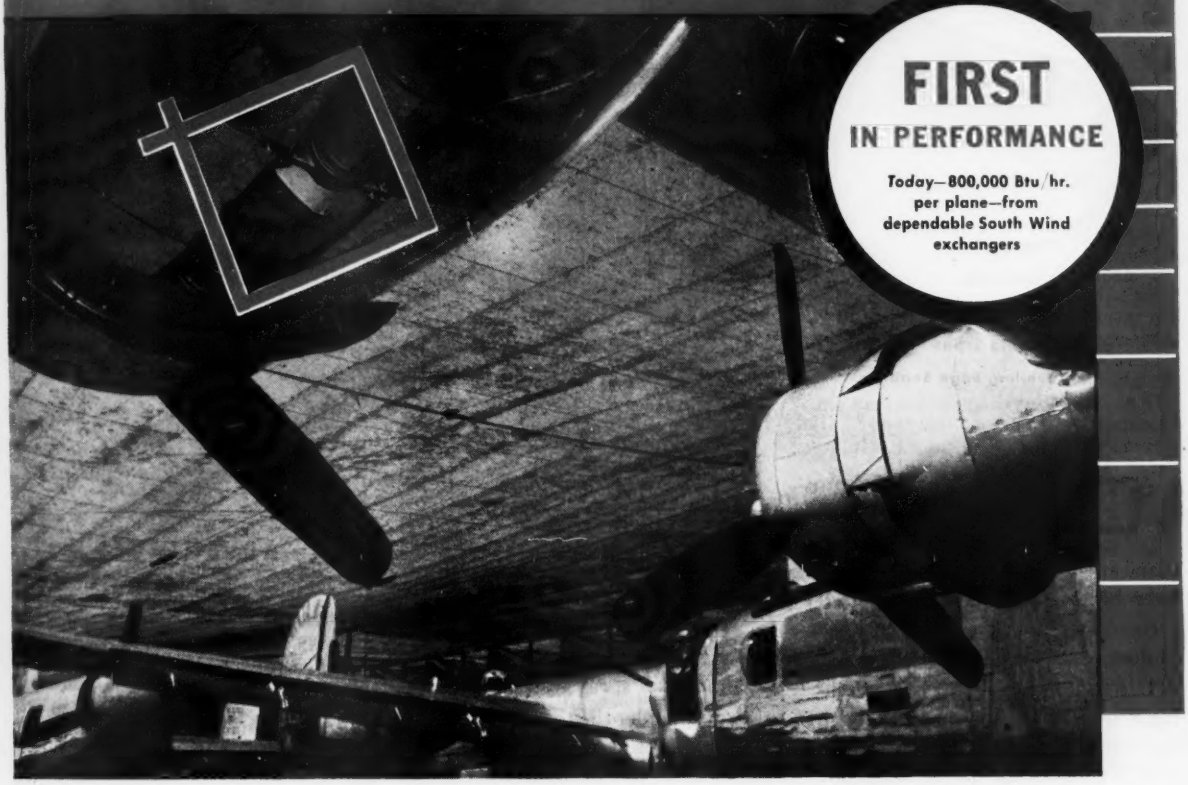

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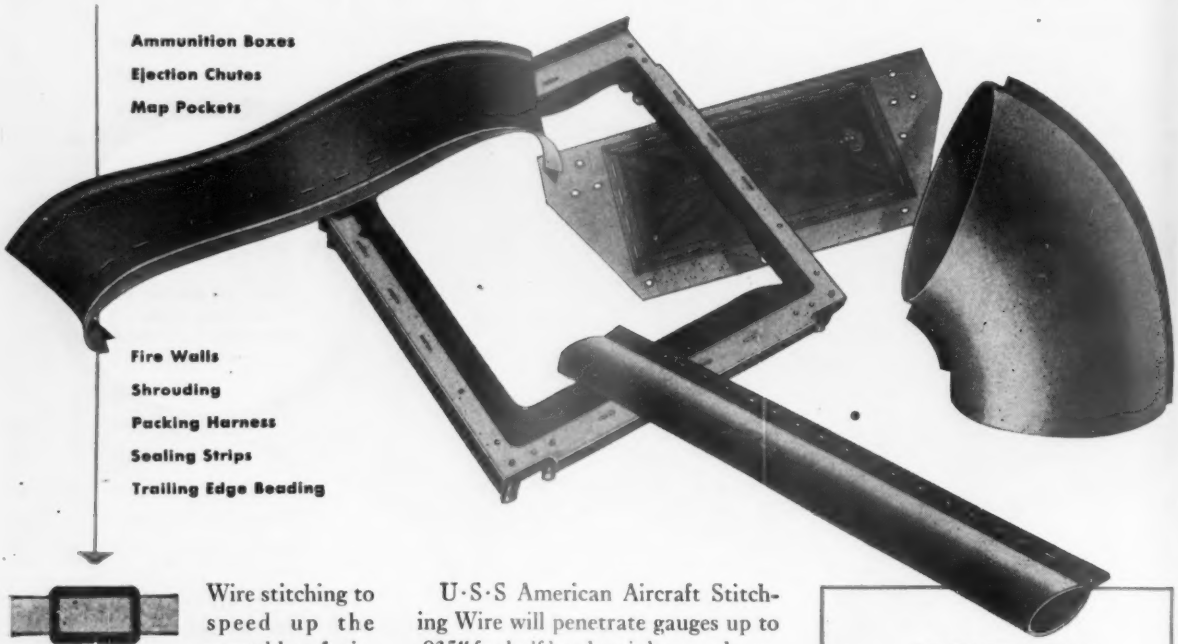

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Nine years of peace and war have brought this change to the famous Boeing Flying Fortress. The top photo is of the original Boeing 299, which was first flown on July 28, 1935, while at the bottom is a similar view of the current model, the B-17G. Battle experience dictated countless changes. The old 299 carried but five guns. The B-17G bristles with 13 0.50-cal. machine guns. Note the chin turret and its supplementary cheek guns, the belly and top turrets, and the tail gun position. The sweeping dorsal fin of the latest model gives the bomber greater stability and is one of the chief identification characteristics of the Flying Fortress.

Invasion by Air. A report of the role played by air forces in the recent Allied invasion of France. The versatility and flexibility with which the air divisions were employed on "D"-Day are demonstrated, and the contributions of the air forces in weakening the enemy during the months preceding the invasion are summarized. In addition to outlining the "D"-Day pattern of air invasion, the article also presents a survey of the basic aircraft categories, specific types of airplanes, and the kind of operations each performed during the first days of invasion. The composition of the Allied Expeditionary Air Force is reviewed; the negligible performance of the German air force in combating the invading aircraft is noted; and, on the basis of the Allied drive into France, the claim is made that invasions can be launched and supplied entirely by air. *Flying*, August, 1944, pages 21–23, 76, 146, 150, 3 illus.

Liaison for Victory. Beryl D. Kneen. The cooperation between the Army, Navy, and Marine Air Forces of the United States, as well as between the air forces of the United States and those of their Allies, is cited. Dwelling particularly on the coordination of the U.S. Air Forces, the writer tells how the liaison extends beyond the operational setup and the rotation of staff officers. He describes how the combat efforts of the three are combined, how the men fly and live together, and the constant interchange of services and equipment. *Flying Aces*, August, 1944, pages 26, 27, 53–56, 5 illus.

Weight Control

How Much Is a Pound Worth? In this paper an attempt has been made to determine a rational value for saving a pound of weight to the air-line operator. It is concluded that the value will differ with each operator even though identical equipment is used. Therefore, to determine the value of a pound for design purposes, it is necessary to base the study on the proposed operation that the airplane is to be subjected to by the particular customer.

The use of a chart of a type illustrated for an "example" airplane is suggested. It is noted that examination of the slope of the curves reveals that in every case the value of a pound of weight varies with the amount of overload. The preparation of charts similar to the one shown is described. It is stated that if the aircraft manufacturer knows the value of the pound to the air-line operator, he will have a basis on which to establish a policy for redesign to save weight. The cost of operating an air line is discussed in some detail. *Weight Engineering*, Summer, 1944, pages 24, 25, 28, 3 illus.; "Featherweights on Wheels," *Popular Mechanics*, July, 1944, pages 76–78, 154, 10 illus.

Tail Down Weighing Problems. M. Francis Taylor. The writer gives the results of a study which indicate that accuracy in weighing aircraft sufficient for field service can be obtained with nonlevel weighings. It is recommended, however, that the present level-weighing procedure be retained in the Handbook of Weight and Balance Data, AN 01-1-40, and that any Tail Down Charts or data be added as supplementary information to be used only when leveling facilities are inadequate. *Weight Engineering*, Summer, 1944, pages 46–48, 4 illus.

Chicago and Southern Saves 400 Pounds. Russell F. Peete, Jr. How the Chicago and Southern Air Lines keep the fleet basic weight as low as possible by removing any item from the plane which will not pay for itself in operation or by employing a lighter-weight substitute when it can be found and utilized without impairing operation. Items that have been removed from the air-line's transport planes to decrease the empty weight are listed.. The aggregate weight of the items removed is tabulated at 416 lbs. The method of loading planes is described, and the tabular loading chart used by this air line is illustrated. *Weight Engineering*, Summer, 1944, page 22, 1 illus.

Weight Control Performance. H. U. Gangelhoff. Noting that any analysis of commercial air-line weight control immediately reveals the need for standardization, the writer proceeds to summarize the Northwest Airlines, Inc., system of weight and balance control as applied to the DC-3 in commercial operation. The subject is confined to problems that are generally common to all air carriers irrespective of the type of equipment operated. Emphasis is placed on the general problems involved, such as actual weighing of the airplane, methods of recording weight variations, the maintaining of charts and graphs as a control on weight accumulation, and operations procedure with respect to the particular loading system employed. The tabular loading-chart system is explained, and examples are given of the methods of preparing weight and balance calculations. *Weight Engineering*, Summer, 1944, pages 9, 10, 34, 35, 4 illus.

Reconvert to Greater Payloads. Midge Winters. Methods of weight-saving developed by Western Air Lines to enable its transport planes to carry greater pay loads are outlined. The reconversion of a DC-3 returned to the air line by the Army is described. Through the company's weight-saving program, the plane was trimmed down so that it could carry 313 lbs. of additional pay load. By the use of a glass fabric inner lining, a weight of 71 lbs. was saved. A streamlined passenger chair that

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weighed 7½ lbs. less than the type formerly used was developed and saved 157½ lbs. in the entire seating installation. *Weight Engineering*, Summer, 1944, pages 20, 21, 2 illus.

Weight and Balance Analysis of ATA-A1. O. C. Kotteman. The writer analyzes the weight and balance characteristics of the feeder-type air transport proposed by a committee of air-line engineers. The design was crystallized under the auspices of the Air Transport Association of America and bears the designation ATA-A1. The characteristics of weight and balance are examined in detail, with tabulated figures for the various conditions assumed. A drawing shows the pay-load arrangement and the balance characteristics.

From the study it is concluded that the weight characteristics of the plane are sound but that the balance characteristics are not. Three suggestions are made for improving the design. *Weight Engineering*, Summer, 1944, pages 14, 15, 31, 32, 1 illus.

Airline Weight Procedures. W. L. Flinn. The weight and balance functions of the Pennsylvania-Central Airlines' engineering department are outlined. The article describes the control of weight resulting from the modification of equipment, the bookkeeping system for weight control, and the methods of operating and loading the airplane. *Weight Engineering*, Summer, 1944, pages 17, 36, 1 illus.

Weight vs. Serviceability in Furnishings. L. S. Nordlinger, Jr. In this article on transport-plane furnishings the writer discusses the problem of obtaining the maximum amount of serviceability with the least amount of weight. It is stated that the best solution to this problem is in the close cooperation between the weight and service engineers and the design group during the preliminary design stage of the item in question. Subjects considered include the design of the multiple passenger chair, wash-water system design, and designing the galley with a view to the efficient utilization of available space. *Weight Engineering*, Summer, 1944, pages 43, 49, 1 illus.

Welding

Welding Fixtures. Part II: Production of a Tubular Engine Mounting for an In-line Power Unit. Harold B. Pereira. Concluding half of a two-part article offering suggestions on how to design work-holding equipment for welding operations. In Part II, the design of work-holding equipment is considered for an engine mount of welded tubular construction. The particular mount discussed is of the type usually adopted for in-line power-plant installations. The topical headings under which the subject is outlined are as follows: engine-foot adapter, structural details, fixture design, welding stages, and methods of clamping. *Aircraft Production*, July, 1944, pages 352–354, 9 illus.

A Paper on Multi-Arc Welding of Aluminum Alloys. Malcolm R. Rivenburgh and C. Weston Steward. It is noted that new methods of joining 24S-T Alclad aluminum should be and are being considered. Difficulties involved in the arc welding of aluminum and its alloys when the sheet thickness is less than ⅛ in. are outlined. The multi-arc welding process, which was invented in connection with a project on the development of a method for the arc welding of this metal, is described. Test data are tabulated on joints welded by the new process and by the oxyacetylene process. Welds made by the multi-arc process are illustrated. It is explained that the tests conducted so far are of a preliminary nature and that further experimental work has been planned. *The Welding Journal*, July, 1944, pages 344-s–350-s, 31 illus.

Miscellaneous

New Records Needed. John P. V. Heinmuller. Indicating the value of record flights to stimulate aeronautical development, the writer mentions some outstanding records set by American fliers. He also reviews the instruments and methods used for measuring record trials. Among these, the camera-chronograph system of timing is featured. Two supplementary charts demonstrate how aviation progress can be traced through the records of the Federation Aeronautique Internationale. *National Aeronautics*, July, 1944, pages 12–15, 26, 2 illus.

Handling and Packaging of Spare Parts at the Willow Run Plant. Franklin M. Reck. As practiced at the Willow Run plant, the Ford Motor Company's system of preparing aircraft spares for shipment is detailed. The article contains information about the scheduling of deliveries, the conveyer system of packing and tagging, the simplification of the spare-parts list, the shipping procedure, and the paper work involved. It tells how emergency orders are handled, gives particulars on the types of containers used for various components, and describes the stuffing, waterproofing, and labeling of packages. *Aero Digest*, July 15, 1944, pages 92, 94, 96, 133, 8 illus.

(*Continued from page 43*)

Conclusion

The type of long-span reinforced concrete arched shell construction described in this paper is based on sound engineering principles and has some important advantages over other constructions which may be summarized as follows:

(1) Low annual cost of maintenance, operating, and depreciation.

(2) Fire-resisting construction, reducing insurance cost and eliminating danger of interruption of service through loss of the building from fire.

(3) It is suitable for any span that may be desired to house aircraft and any combination of facilities that may be desired in connection with a hangar.

(4) Its construction makes use of a large proportion of local labor and materials resulting in economy, and local employment and good will for the owner.

(5) Concrete construction is economical in most foreign countries where air lines will have important stations.

(6) Improved operating conditions result from the better interior clearances and the smooth white concrete ceiling, and from the elimination of a large amount of steelwork which accumulates dust and requires painting.

This type of construction is particularly suitable for the large structures that will be needed by the air lines after the war and should be given careful consideration when such structures are planned.

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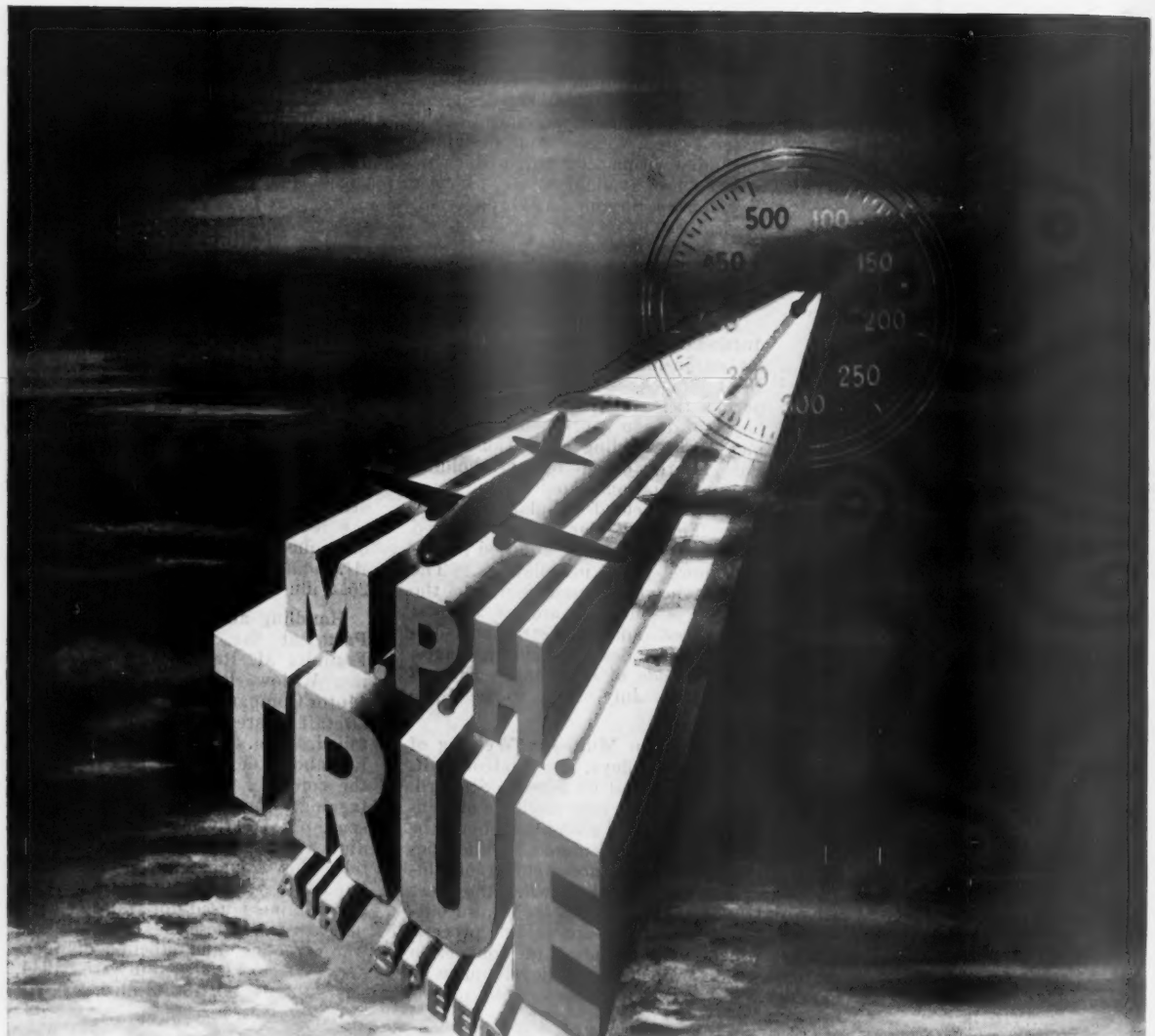

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Air Power in the Invasion. A report cabled by staff correspondents of the Air Forces in the European Theater of Operations gives an account of the performance of the various air commands on the day of the invasion of the European Continent. It tells the story of the contribution of air power to the success of the operation and relates numerous incidents of the planning and execution of the campaign. It is noted that the function of the air units was divided into four phases. The first was the driving of the Luftwaffe back into Germany by dealing heavy blows against the war-making power of the enemy through bombing his plants and destroying his aircraft. The second phase was the interruption of the enemy's communications by bombing railroads, highways, canals, bridges, and other facilities through which supplies were sent to the "Atlantic Wall." The third function was the observation of as much as possible of the enemy's preparations for defense against invasion and the prevention of observation by the enemy of Allied preparations. The fourth and perhaps the supreme contribution of air power was the attack on the enemy's defenses before and during the landings. Details are given about the work of the different types of aircraft used, the numbers engaged, the tonnage of bombs dropped, and the ways in which air power assisted in the first few days after the landing. *Air Force*, July, 1944.

Navigators Can't Daydream. Numerous incidents are related to show the serious consequences of errors on the part of the navigator, emphasizing the importance of his work. Various cases are analyzed in a narrative style, showing how the flights were led astray and why they missed their objectives. Some of these failures had serious consequences, and in other cases accidents were avoided by skillful flying. *Air Force*, July, 1944.

Battleground of the Air. A collection of short articles is brought together under a single heading. The articles recount the work of various sections of the Army Air Forces Weather Service. The individual articles are as follows: "Weather in Your Hat," by Capt. Luther Davis; "Atmospheric Terrain" and "The AAF Weather Service," by Col. W. O. Senter; "Serving Other Arms" and "Cavu at Paramushiru," by Capt. Virgil E. Sandifer; "Makin's Weather and Japs," by Lt. Les Goldberg; "'Met' Boys in the South Pacific," Sgt. John Fitting, Jr. *Air Force*, July, 1944.

Feeding the AAF. Capt. Benjamin J. Grant, Jr. Details are given concerning the magnitude of the task of providing food supplies for the Army Air Forces in the different theaters throughout the world. In addition to figures showing the volume of food that must be provided, there are discussions of the dietetic aspects and information about the scientific tests that are applied in the selection, packaging, and delivery of food supplies. Incidents are included of the difficulties overcome in transporting food supplies to Army air bases. *Air Force*, July, 1944.

Materiel Command Reveals Details of New P-63 Fighter. The new P-63 Kingcobra is essentially a heavier, more powerful version of the Bell P-39 Airacobra. Though it differs only slightly in appearance from the Airacobra, the P-63 is about 700 lbs. heavier than the 7,650-lb. P-39 and has a wing span of slightly over 38 ft., an increase of 4 ft.

The chief change is in the power plant. The P-63 has a two-stage Allison 1,500-hp. engine which gives increased power and speed over the single-stage Allison, which powers the P-39. The two-stage engine gives higher compression through the use of a fuel supercharger geared at one speed for medium altitudes and at a higher speed for high-altitude flying. The horsepower increase is rated at 300.

Instead of the three-bladed propeller used on the Airacobra, the P-63 is equipped with a four-bladed propeller. Its service ceiling is 35,000 ft., an increase of 5,000 ft. over the P-39.

Another feature added to the Kingcobra by Matériel Command engineers is the laminar-flow wing, developed to give better lift and maneuverability. The armament has also been increased. The P-63 carries a 37-mm. cannon firing through the propeller hub and four 0.50-caliber machine guns, two installed in the wings and two in the nose, firing through the propeller arc.

To give the P-63 added range, droppable belly and wing tanks are added whenever the mission or theater requirement makes it necessary. The official combat radius of the P-63 is 50 per cent greater than that of the P-39. - *A.A.F. Matériel Command.*

After D-Day. Major Arthur Gordon. In this report on the air war, the writer tells of several events that took place after the invasion. He discusses three developments of major importance which were introduced by Allied air power, one long-range strategic plan which was brought to a climax, and the innovation of flying bombs by the Germans. The strategic plan is the destruction of the German petroleum industry, with its climax the large-scale air attack of June 20 against oil plants and military targets inside Germany. The three developments are triangular shuttle bombing between Britain, the U.S.S.R., and Italy; large-scale daylight bombing by the R.A.F.; and high-altitude precision fighter bombing. Allied pre-invasion bombing is credited with having delayed the advent of the German flying-bomb attacks by 6 months and reducing them to about 10 per cent of the planned intensity. Defensive measures, such as antiaircraft fire, fighter interception, and barrage balloons, are reported to be increasingly effective. *Air Force*, August, 1944.

Invasion of France. Capt. Luther Davis. An account of the Ninth Air Forces' activities from the period 30 days previous to D-Day until 10 days after the invasion. Varying according to the phase of operations, the diversity of their missions is recounted through the preliminary stage ("D-Day-minus-30" to "D-Day-minus-3"), the preparatory stage ("D-Day-minus-3" to D-Day), and the assault stage (D-Day through "D-Day-plus-one") of the invasion, as well as through the 10 days following. The cutting of communications, the blasting of airdromes, the destruction of enemy tactical targets, and the support of ground troops are among the operations described. *Air Force*, August, 1944.

Centrifuge Used in "Blackout" Study. The Aero-Medical laboratory of the A.A.F. Matériel Command has made use of the principle of the centrifuge in its study of "blackout," the temporary loss of perception by pilots during violent flight maneuvers. The centrifuge resembles a large, two-arm merry-go-round with a man-carrying cab or cockpit at the end of each arm. It is spun by a 250-hp. electric motor. In the center of the revolving structure is a seat for an observer.

The test subject—always a volunteer—sits in one of the cabs, the ob-

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server facing him. When the centrifuge is started, the cab swings outward, putting the subject in a position parallel to the plane of the circle his body describes, head toward the center. Thus the motion duplicates exactly the force of an airplane pulling out of a dive. The force can be lessened or increased by varying the speed of the centrifuge.

The centrifuge has shown that the average flier can withstand more positive acceleration than negative. Usually he will blackout at about plus 4 or 5*g*. But his sight returns to normal almost immediately when the force is removed. At high *g* levels consciousness is lost. From this condition, 15 sec. at least are required for recovery. Maximum tolerance for minus *g* is about 3. A continued minus *g* force may lead to serious eye or brain injury.

Tests are run in darkness to avoid the visual distraction of the walls whirling by. A predrawn chart fixes the entire operation of the centrifuge. This chart is placed in the control mechanism and gives a scientific stability to the experiment not possible under actual flight conditions. The subject can, of course, cause the test to be stopped at any time for any reason.

Special instruments record the subject's reactions. An electrocardiograph, a brain wave recorder, a photoelectric eye for measuring blood volume in tissue and to take pulse and respiration are all attached to the "pilot." His reactions are timed through the use of lights and buzzers on a panel in front of him. These are turned off by the subject, and the time necessary for him to throw the switches determines his alertness and state of consciousness.

Valuable data have already been collected by the Matériel Command from centrifuge tests. Aero-Medical specialists know now that a tense pilot, or one who "yells" during a dive pull-out, is much less susceptible to blacking out than a relaxed pilot. It has also been proved that taping the body and using a prone or crouch position (which the Germans provide for in dive bombers) have merit. *A.A.F. Matériel Command*, Wright Field.

Our First Four Airfields in Normandy. The story is told of how the first four American advanced landing fields in Normandy were constructed by the Engineer Command of the Ninth Air Force with speed, tenacity, and heroism. In addition to this report, the article outlines the phasing through which a typical landing strip goes and gives the specifications for each phase. It also reviews the background history of the Ninth Engineer Command and lists the missions for which it was created. *Air Force*, August, 1944.

High-Altitude Flying Suit. Extensive experimental work by the Matériel Command has resulted in the development of an improved high-altitude flying suit, designated as the

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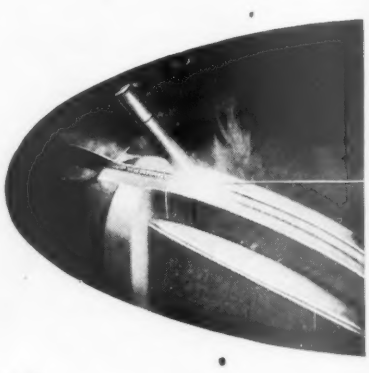

Any good welder can join magnesium alloys as readily as he can other metals. *Gas welding* is well adapted to the making of butt welds; fluxes are available for this type of weld. In *arc welding* (illustrated at the right) a tungsten electrode is used, and the weld area is shielded from air by a screen of inert gas, such as helium or argon, thus eliminating the need of fluxes. Lap, butt, edge and fillet welds can be made by this method. Magnesium alloys can readily be *spot welded* to each other. Less current density is required because of the lower electrical conductivity of magnesium alloys in comparison with aluminum. Clean metal and clean electrodes will insure a better spot weld.

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F-3, which currently is being made available in overseas theaters.

The two-piece design has been retained because it permits better fitting for men of varying physical measurements, with a minimum of sizes to be stocked. The F-3 suit consists of overall-like trousers and jacket, worn over ordinary dress. Ordinary dress is long underwear and regular government-issue woolen olive-drab clothing. The outer garment is also a new development, an intermediate-weight, alpaca-lined flying suit, which is less bulky than the heavy, unheated, sheepskin-lined leather winter flying clothing. Despite its apparent lightness, the intermediate suit is comfortable without the electrically heated unit in temperatures as low as +20°F.

Completing the costume are electrically heated shoes over which are worn flying boots or a special felt shoe for a ball-turret gunner. Heated gloves are worn over rayon glove inserts and under an insulative mitten. Two electrical circuits are built into gloves, shoes, and jacket, and three in the trousers, so that only part of the heat is lost if one of the unit circuits should fail.

Six-foot extensions on jacket-attached lead cords furnish electrical connections to rheostats built in at combat stations throughout the plane. The plugs lock with simple clockwise twists to prevent accidental disconnections. The rheostats are adjustable to provide maximum comfort. Minimum amounts of heat are recommended to avoid perspiration at lower altitudes. Matériel Command engineers are conducting experiments on two new types of thermostats which eventually may eliminate the need for the adjustable rheostat. One is a single external unit actuated by temperature changes in surrounding air and by increase and decrease in air movement.

A manufacturer's model of the earlier F-2 suit now incorporates multiple thermostats throughout the suit, including gloves and shoes, giving individual control to each unit. Such thermostats are not bulky and do not hamper efficiency to any great extent, being small cylinders approximately 1/4 in. in diameter and slightly more than 1 in. long.

The electrically heated suit assembly is designed to maintain top body efficiency during routine flight, training, or combat flying for all temperature conditions down to —40°F. at sea level, regardless of the flight's duration. This is comparable to —60°F. at 30,000 ft. because of the lighter air density at higher altitudes.

The adequacy of electrically heated clothing has been tested thoroughly by Matériel Command specialists. Eight men spent eight consecutive hours at —55°F. A 15-m.p.h. wind added to the rigors of the test. Electrically heated clothing provided complete protection that would not have been possible with present types of unheated clothing. The safety of the electrical suits also has been demonstrated. The wire used in one test withstood reverse bending to 90° for more than 500,000 cycles without breaking. Farmers wore several pairs of electrically heated gloves as work gloves. The leather wore out, but the wiring remained in first-class condition. Other emergencies were provided for, such as protection while bailing out and walking back under conditions of exposure to the elements. *A.A.F. Matériel Command*, Wright Field.

Our Rocket-Slinging Fighters. Lt. Col. H. L. Donicht. This is an article on the development of rocket-gun installations for aircraft. Explaining the principles of rocket guns, it tells how they are positioned on fighter airplanes, how they are fired by the pilot, and the specific purposes for which they are used. The air-borne rocket guns are designated as the "heavy artillery" of the A.A.F., and reasons are given why they are used almost exclusively against ground targets. *Air Force*, August, 1944.

Gun Cameras Aid Fighter Pilots. Every fighter aircraft in the A.A.F. is now, or soon will be, equipped with a gun camera. This 16-mm. motion-picture camera can accurately record the firing and tracking of a combat pilot under almost impossible conditions and can obtain valuable information about performance and design changes on enemy aircraft.

When the pilot returns from his mission he may step into a projection room and see how he hit or how he missed the enemy. Perhaps he may discover that a new turret has been placed in a previously vulnerable spot on an enemy bomber. From this film, he can count his victories and see his errors. The film is also valuable for training of fledgling fighter pilots. When the scenes of the actual combat are shown to these men they can profit from the successes and mistakes of others.

The camera is loaded with a 50-ft. roll of 16-mm. motion-picture film allowing 2,000 exposures. A knob can vary its speed from 16 to 64 frames per sec. As it must be able to function within a temperature range of —65° to +165° it includes a heater, thermostatically controlled. It is light and compact, weighing 3 1/2 lbs. and measuring 6 by 3 1/2 by 2 1/2 in.

The cameras are mounted in the nose, the wing, or fuselage of the various types of fighters. One of the principal difficulties encountered by Matériel Command engineers was the mounting of the camera to minimize the vibration caused by the engine and the firing of the guns so that pictures as clear and distinct as possible might be obtained. Such a mounting has been perfected.

The camera is operated simultaneously with the firing of the guns. Not only is the camera ingeniously boresighted with the plane's gun sight but it has an attachment that allows the film to overrun the firing burst by 3 or 4 sec. in order to record the effect of the burst on the enemy aircraft.

The current model now standard to the Air Forces is the AN-N6 designed by the Fairchild Camera and Instrument Corporation and the Bell & Howell Company, who collaborated with the Armament Laboratory. *A.A.F. Matériel Command*, Wright Field.

H-Hour Minus Four and a Half. The role played by the Troop Carrier Command in the "H hours" operations of the Western European invasion is recorded. Descriptions are given of the assignment, the carrying out of the operations, and the background that prepared the Troop Carrier Command for the successful completion of its D-Day missions. *Air Force*, August, 1944.

Bureau of Aeronautics

Fog. This is the third of a series of booklets on aerological subjects prepared for Naval Aviation cadets. It describes how fog forms, the various types of fog, fog forecasting, and the dissipation of fog. A short glossary containing common terms is included in the booklet. *Training Division of the Bureau of Aeronautics*, Aerology Series No. 3.

Bureau of Naval Personnel

A Sailor's Reader is the title of a booklet telling about the U.S. Navy. It explains what the Navy does and what it can do for men enlisting in it. Types of Navy ships, including aircraft carriers, are described in one section. *NAVPERS* 16109, *Training Division, Standards and Curriculum Section*, January, 1944. For sale by the Superintendent of Documents, Washington, D.C., $0.15.

Civil Aeronautics Administration

The Development of a Mechanical Cement Spreader and Accessories for Use in Soil Cement Construction. R. C. Mainfort. In recent years it has been found that portland cement combined with certain types of soils produces material suitable for low-cost road and airport construction. This type of treatment is referred to as soil-cement stabilization, and numerous civil and military airports have utilized this method in the construction of surfaces and base courses. It has been the general practice to apply the cement to the soil by hand, an operation that, in addition to being slow and labor-consuming, often results in an improper dispersion of the cement.

With the approval of the U.S. Army Air Forces and the endorsement of the Secretary of War, the Technical Development Division of the Civil Aeronautics Administration initiated the project of developing a mechanical cement spreader capable of providing a more speedy and accurate method of applying portland cement to soil that had been prepared for stabilization. This project has now been completed and a description of the develop-

ment and operation of the equipment is contained in this report.

The spreader will give an even distribution of cement over an area 6 ft. wide, in any controllable amount between 0.3 and 0.75 cu.ft. per sq.yd. of surface (approximately 6 to 16 per cent by volume of compacted soil for 6-in. thickness) at forward speeds up to 150 ft. per min. The quantity of cement so spread can be controlled within a variation of less than 1 per cent based on the volume of compacted soil. The unit is suitable for use with either bulk or sacked cement and is designed to be towed by truck or tractor.

In order that the equipment may be transported to remote combat areas by air, it has been designed so that all units can be broken down into easily assembled parts, each of which will conveniently fit into military transport planes. *Technical Development Report No. 41*, May, 1944.

Propeller Diameters, Controllable Pitch and Constant Speed. The purpose of this release is to clarify a number of questions that have arisen regarding limitations associated with approved propeller diameters. This information does not apply to fixed-pitch and adjustable (on the ground) pitch propellers because the approved diameter limitations for such propellers are indicated in the specification of the aircraft models using these propellers.

Explanations are given for the approved diameter limits and the permissible deviation from those limits. General instructions are given for calculating permissible diameter reductions, and a tabulation shows the amount of correction to be added to the blade radius of the various hub models. *Safety Regulation Release No. 163*, June 15, 1944.

Civil Aeronautics Board

Uniform System of Accounts for International Air Carriers. This volume is published in accordance with the Civil Aeronautics Act of 1938, as amended, requiring air carriers to keep all accounts, records, and memorandums in the form prescribed or approved by the Civil Aeronautics Board. It contains instructions for procedures in accordance with these regulations. The main sections of the book refer to balance-sheet accounts, operating-revenue accounts, operating-expense accounts, income accounts, and reporting procedure. Five annual-report schedules are included. Directions are given in great detail for the keeping of records, accounting periods, allocation of revenues and expenses, delayed items, foreign exchange, contingent assets and liabilities, affiliated and associated companies, interpreting of item lists, and submission of questions. An index of approximately 500 items gives reference to the appropriate section and page. *CAB Form 2380 Manual 1-1-43.* For Sale by the Superintendent of Documents, Washington, D.C., $0.50.

Civil Air Patrol

Two official pamphlets, one on how to form a C.A.P. unit and the other an illustrated brochure on the C.A.P. Cadet program, have been printed by the Recruiting Publicity Bureau, U.S. Army, and are being distributed to all units of the Civil Air Patrol. They are intended to assist in the formation of new C.A.P. units and in recruiting new members. The pamphlet on "How to Form a CAP Unit in Your Area" refers to the Patrol as a "double opportunity" for aviation enthusiasts —a chance to help the war effort and at the same time to build for aviation's future. It contains 16 pages and will be useful in enlisting the help of local pilots, civic groups, school authorities, and other citizens in areas where C.A.P. units have not been formed.

"How Civil Air Patrol Helps You Win Your Wings" is a 24-page illustrated booklet especially addressed to prospective C.A.P. Cadet recruits and to their parents but may serve a variety of other purposes. City officials, school authorities, civic groups, aviation committees of chambers of commerce, local flight operators, and others are expected to be helpful in this effort through the use of the pamphlets. *CAP News Bulletin*, July 28, 1944.

National Advisory Committee for Aeronautics

Gas Jets. S. Chaplygin. From a translation of *Scientific Memoirs*, Moscow University, 1902. By using the method presented it is possible, in many cases, to find the solution of a given problem on the flow of an ideal gas. Here it is necessary to impose all the conditions that are assumed in the analogous problems of an incompressible liquid as previously mentioned by Joukowsky.

But, in addition, the applicability of the analysis here developed is further restricted by the special requirement that thevelocity of the gas particles must nowhere exceed the velocity of sound for the particular physical state of the gas at a given point (local velocity of sound). Corresponding restrictions are likewise imposed on the limits within which the pressure may vary. If this additional condition is not satisfied, stable motion apparently is not possible. It is assumed, however, that with the aid of a certain hypothesis, stated in this paper, the problem can also be analyzed for the case where the additional condition is not satisfied. The mathematical treatment of this problem, however, is left to another paper.

In part I the differential equations of the problem of a gas flow in two dimensions are derived, and the particular integrals by which the problem on jets is solved are given. Use is made of the same independent variables as Molenbroek used, but it is found to be more suitable to consider other functions. The stream function and velocity potential corresponding to the problem are given in the form of a series.

The investigation of the convergence of these series in connection with certain properties of the functions entering them forms the subject of part II. In part III the problem of the outflow of a gas from an infinite vessel with plane walls is solved. In part IV the impact of a gas jet on a plate is considered, and the limiting case where the jet expands to infinity, changing into a gas flow, is taken up in greater detail. This also solved the equivalent problem of the resistance of a gaseous medium to the motion of a plate. Finally, in part V, an approximate method is presented that permits a simpler solution of the problem of jet flows in the case where the velocities of the gas (velocities of the particles in the gas) are not large.

Supplementary notes are appended at the end of this report, the second of which establishes a relation between the analysis of part V with certain problems in the theory of minimal surfaces.

The results obtained in parts III and IV, at least qualitatively, agree sufficiently well with test results, although the experimental investigation of the phenomena accompanying the jet formation was conducted under conditions very different from those assumed in these theoretical investigations. The principles of the method with its application to flows presented here were briefly communicated to the Moscow Mathematical Society at the beginning of 1896. A more detailed presentation was made at the eleventh session in 1901. *N.A.C.A. T.M. No. 1063*, 112 pp., August, 1944.

Integral Methods in the Theory of the Boundary Layer. L. G. Loitsianskii. Translation from the Institute of Mechanics of the U.S.S.R. Academy of Sciences, Applied Mathematics and Mechanics, Vol. V, No. 3, 1941. This paper deals with the method of the variation of the thickness of the boundary layer. A number of new approximate formulas valuable in aerodynamic calculations for the friction distribution are derived from this procedure. The method has been applied only to laminar boundary layers, but it seems probable that it may be generalized to include turbulent layers as well.

In the present paper use is made of a single general principle of mechanics which, as far as is known, has not yet been applied in hydrodynamics and, in analytical mechanics, bears the name of the Jourdain principle. This principle, which is intermediate between the principles of D'Alembert and Gauss, is convenient for problems of hydrodynamics in the applications of Euler and, in particular, for obtaining "direct" methods of the solution of boundary layer problems.

The assigning of a particular form for the velocity variation in the expression of the Jourdain principle leads

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to the equation of von Kármán, the system of equations of Leibenson-Golubev, and other methods that may be useful in applications. *N.A.C.A. T.M. No. 1070,* July, 1944.

Navy Department

New Navy Films for War Industry Showings. As a part of the activity of the Industrial Incentive Division of the Navy Department, a showing of motion pictures was held on August 2 in the auditorium of the Museum of Modern Art in New York. Five films were exhibited as follows: *Black Cats, Behind Nazi Guns, December 7th, Battle for the Beaches,* and *The Life and Death of the Hornet.* These films are listed in the "restricted" category and are available to industrial plants engaged in war work for exhibition to their employees as a part of the effort to stimulate industrial production of war materials.

The film *The Black Cats* was photographed, edited, and completed by the Naval personnel in the South Pacific, and no changes were found necessary in its continuity or presentation before it was released for exhibition. It shows the accomplishments of the Consolidated PBY Catalina patrol bombers not only in observation and reconnaissance work but in actual attacks with bombs and torpedoes against Japanese combat and merchant ships and aircraft.

Behind Nazi Guns consists largely of captured German films showing the war effort being made by the enemy and some of the damage that is being done to German industry by Allied air power.

December 7th depicts the attack by the Japanese at Pearl Harbor. It was chosen as the "best documentary short subject of the year" by the Motion Picture Academy of Arts and Sciences. It shows in detail the destruction wrought and the reconstruction work that followed.

Battle for the Beaches emphasizes the importance of amphibious warfare in Africa, Europe, and the Far East. It shows how landing craft of large and small size are contributing to the skillful invasion of enemy territory, which in many cases consists of attacks and landings directly on the beaches held by enemy forces.

The Life and Death of the Hornet traces the story of one of America's famous aircraft carriers from its construction and launching, through the important battles in which it took part to its destruction by American gunfire and torpedoes after it had been so severely damaged by enemy bombs as to be beyond salvage. *Industrial Incentive Division, U.S. Navy Department.*

New York State Department of Commerce

New York Means Business. A booklet of 48 pages, profusely illustrated in color, gives a survey of the industrial development of the State of New York. It is intended to convey to business men the many opportunities offered by the State for the establishment and expansion of industrial enterprises. It shows not only the diversification of industry and agriculture but indicates the extensive marketing territories provided by the population of the State.

Among other things it is noted that New York and its six boundary states contain 26.33 per cent of the population of the United States; individuals in the territory received 35.28 per cent of the national income; its consumption of electrical energy was 31.51 per cent of that of the entire nation. Its motor vehicle registration totals 23.91 per cent of all the United States, and retail sales were 31.26 per cent of the United States total. Charts and tables give other statistics showing the extent and variety of the markets offered by the people of New York.

In the section outlining the State's transportation facilities, there is a map showing the established commercial air routes, airports, and other facilities available for air transportation. Other pages give information about the State's agricultural products, man power, and other basic factors, as well as specific information regarding some of the leading industries in the State.

The Port of New York Authority

With all measurements centering on the New York-New Jersey area, an air map known as an "azimuthal equidistant projection" shows every straight line out of the Port of New York as a great-circle route on which air distances may be scaled on a straight line. The map shows the savings in distance, and therefore in time and cost, that will be had from direct air routes to all points in the Caribbean and to South America.

An azimuthal map is one that maintains the true direction of all points on the earth's surface, away from one selected point. Some interesting contrasts may be seen between distances measured on the Mercator projection and those indicated on the azimuthal projection. For example, on the Mercator, the distance from New York to London appears to be approximately the same as that from New York to Rio de Janeiro. On the azimuthal, it is clear that Rio de Janeiro is 1,300 miles farther from New York than is London. Similarly, the Mercator projection indicates that San Juan, Porto Rico, is closer to New Orleans than it is to New York. Actually, San Juan is considerably closer to New York.

The chairman of the Port of New York Authority stated that in 1940, the latest period for which figures are available, 48.6 per cent of the value of America's foreign trade and 22.6 per cent of its volume passed through the Port of New York. The average value of a pound of freight passing through this port was more than double the national average. This high-value freight is particularly susceptible to diversion to air transportation. About 70 per cent of the prewar overseas passenger travelers used the Port of New York. Approximately two-thirds of American citizens traveling abroad lived within the northeastern portion of the United States, over 40 per cent in New York and New Jersey alone. Records of domestic air express revenues show that about one-fourth of all such traffic originates at, or is delivered to, New York.

The Port of New York has a substantial amount of direct service by air to San Francisco and Los Angeles. Yet it lacks any permanently certified direct service to closer points in Central America, the western Caribbean, and northern South America. Under the recent proposal of the Civil Aeronautics Board for 20 postwar international air routes for commercial operation by United States flag air lines, seven of the proposed routes have New York as a terminal. Two more that start at Cristobal and Balboa are extensions into South America of routes that have New York as their terminal in the United States.

The new map was prepared by the American Geographical Society at the suggestion of The Port of New York Authority. It shows most of North America, all of Central and South America, the Caribbean Islands, most of Europe, and western Africa. *The Port of New York Authority.*

Tennessee Valley Authority

Airplane Dusting for the Control of Anopheles Quadrimaculatus on Impounded Waters. C. W. Kruse, A. D. Hess, and R. L. Metcalf. The purpose of this paper is to discuss briefly the major improvements in airplane dusting for the control of insects on the reservoirs of the Tennessee Valley Authority since 1938. These have involved mainly the mechanics of the duster, methods of dust-valve calibration and dust mixing and tagging, the application and evaluation of general field treatment practices, and specifications for Paris green with particular reference to particle size.

A detailed description is given of the dusting plane and the dust hopper, agitators, release valve, venturi, and other special equipment. The type and location of loading strips, training of pilots, etc., are also briefly discussed. The methods of calibrating the rates of discharge and the mixing and tagging of dust are described.

The dusting operation is carried out during the calm period of early morning, and the flying height is usually 20 to 30 ft. Dust distribution has been determined, both by particle counts and by quantitative chemical analysis. The dust distribution curve is noticeably skewed to the left, probably because of the torque of the plane propeller. It appears that about 20 per cent of the Paris green released falls in the central 100 ft. of the dusting swath and another 8 per cent falls

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in the second 100 ft.; the remainder of the dust drifts away from the treatment area and for practical purposes may be considered lost. A chart is presented which shows effective swath widths for 70 and 90 per cent larval kills under varying conditions of plant cover, rate of discharge, and distances between swaths.

Studies on ingestibility, toxicity, and field distribution in relation to particle size indicate the desirability of obtaining a Paris green for airplane dusting of a larger particle size than the ordinary commercially available material. A tentative revision is suggested for the particle size specifications which are to be used in air dusting for malaria control.

War Contracts Price Adjustment Board

Renegotiation Regulations for Fiscal Years Ending After June 30, 1943. This book contains regulations governing the renegotiation of war contracts, adopted by the War Contracts Price Adjustment Board for controlling the renegotiation of contracts and subcontracts. The regulations have been made in accordance with Section 403 of the Sixth Supplemental National Defense Appropriation Act, 1942, as amended, with respect to renegotiation for fiscal years ending after June 30, 1943. The regulations presently published are subject to revision and amendment and to the addition of rulings on subjects not covered therein.

Sections of the book are as follows: Authority and Organization; Procedure for Renegotiation; Determination of Renegotiable Business and Costs; Determination and Elimination of Excessive Profits; Agreements and Statements; Impasse Procedure; Forms for Renegotiation; Text of Statutes, Orders, Joint Regulations and Directives. For Sale by the Superintendent of Documents, Washington, $2.00, including twelve monthly supplements.

War Department

Aviation Engineers. A manual for aviation engineers of the Army Air Forces deals with both tactical and technical phases of their training and operations, with special reference to their employment in theaters of operation. The manual is intended to serve as a guide to those general engineering principles that must be applied to the work of constructing, maintaining, camouflaging, and defending field airdromes.

The general background of the subject is given in sections devoted to the mission, organization, equipment, and training. This is followed by chapters dealing with operations in constructing, maintaining, and defending field airdromes, including methods of using the construction equipment issued to aviation engineers. The subject of camouflage is discussed. There is a chapter on air-borne aviation engi-

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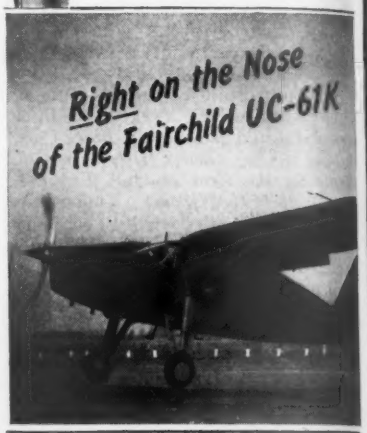

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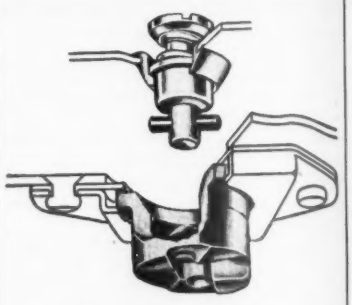

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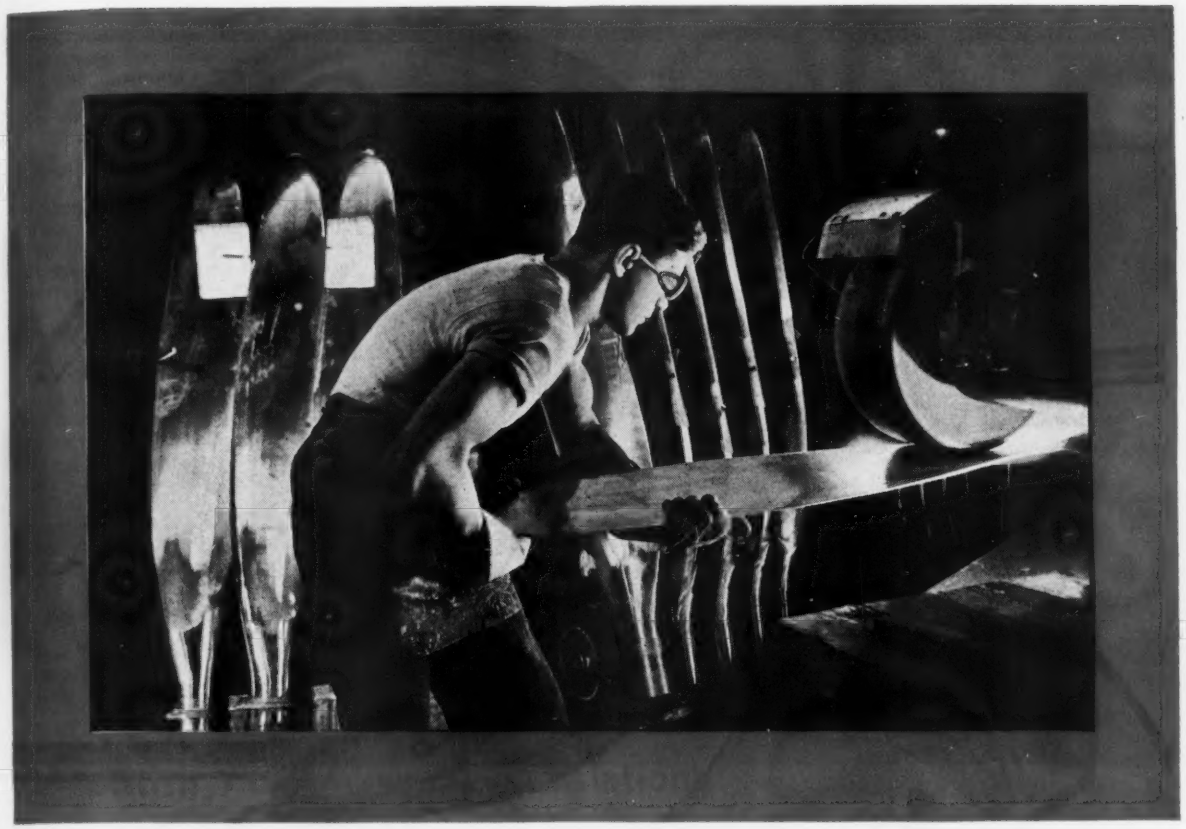

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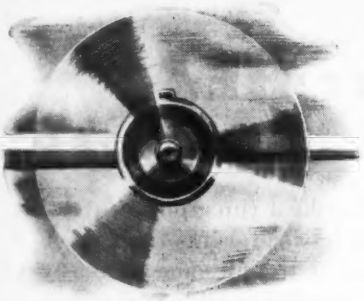

At take-off speed, the centrifugal pull on each of the hollow steel blades of a 16½-foot propeller on one of our largest and fastest aircraft is 97 tons —or a total of 582,000 pounds on the 3 blades.

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There's another reason, too, why thousands of hollow steel "prop" blades are made of *Republic* Electric Furnace Steel—the steel that's *always* as UNIFORM and CLEAN and SOUND as the most expert furnace practice can make it.

The process by which these blades are made is exacting—involves 100 separate operations. The steel must not vary or interfere with rapid flow through the various production steps. It must be consistent in physical, chemical, welding, machining and heat treating properties. It must be homogeneous—free from imperfections which could cause rejection at final inspection and loss of irreplaceable time and costly effort.

Let us tell you how *Republic* Electric Furnace Steels can help YOU produce better products, too—to meet keen competition in peacetime markets. When you use these fine steels, consistent uniformity predetermines costs. Freedom from practice-upsetting variables insures maximum results from mass production methods. "Targeted" quality possible only in electric furnace melting hits narrow specifications on the nose.

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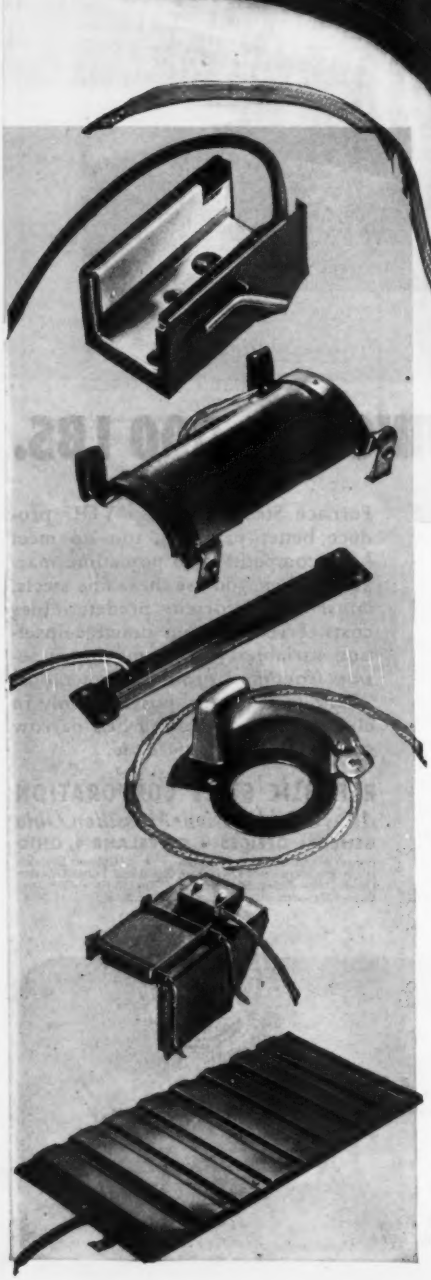

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neers which details their mission, organization, equipment, and training. Technical and reference data are given in appendixes. *Tentative TM 5-255*, December 31, 1942.

War Manpower Commission

Occupations Related to Aircraft Mechanic. This pamphlet, which is one of the Job Family Series, contains suggestions for the economical upgrading and transfer of workers to the occupation of aircraft mechanic. The occupations related to that of aircraft mechanic are listed. The principal factors of relationship are described. Estimates are given of the training time that might be saved by the use of related workers as compared with the training of inexperienced persons. *Job Family Series 0-89, Division of Occupational Analysis and Manning Tables*, January, 1944. For sale by the Superintendent of Documents, Washington, $0.10.

British Information Services

The Calculation of the Total and Skin Friction Drags of Bodies of Revolution at Zero Incidence. A. D. Young. A method is developed for calculating the total and skin-friction drags of bodies of revolution at zero incidence, utilizing the principles and assumptions employed in calculating the profile drag of airfoils. The method is applied to three bodies of different fineness ratio for three Reynolds Numbers and three transition points. From the results curves are drawn showing the variation of total drag for a given range of fineness ratio, Reynolds Numbers, and positions of transition points. Comparison with experimental results shows satisfactory agreement.

Among the deductions resulting from the calculation are: (a) The ratio of form drag to total drag is equal to approximately 40 per cent of the ratio of the maximum diameter of the body to its length; (b) given the volume and transition-point position, the fineness ratio for which the drag is least is about 5 to 1; (c) given the frontal area and transition-point position, the fineness ratio for which the drag is least is about 3 to 1. *Ministry of Aircraft Production, Aeronautical Research Committee, R. & M. No. 1874*, British Information Services, New York, $1.20.

British Air Ministry Translations

The list below supplements those published in previous issues of the AERONAUTICAL ENGINEERING REVIEW.

Aeronautical companies and other organizations may borrow copies of these translations through the facilities of The Paul Kollsman Library upon application by the company librarian. Because of the importance of this material, the regular library loan period has been extended to two weeks, in order that these translations may be utilized to their full advantage. Requests should be made by number, author, and title on the regular Library book request cards. Because of the many requests for these translations, no more than five copies may be borrowed at one time by one organization.

The translations have been reproduced from typewritten copy, and the number of pages in each is indicated at the end of each reference. Bibliographic information has been taken directly from the translations. Photostatic copies are also available at the usual library rates.

2144 Serragli, G. *The exhaust gas turbine.* Rivista aeronautica, v. 17, no. 11, November, 1941, p. 331–344. 8 p.

2145 Hütter, A. *Stress peaks in perforated metal plates and strips.* Zeitschrift für angewandte mathematik und mechanik, v. 22, no. 6, December, 1942, p. 322–335. 20 p.

2146 *Fault detector for hydraulic systems.* Flugsport, v. 36, no. 1, January 19, 1944, p. 5–6. 2 p.

2147 Junkers flugzeug- und motorenwerke aktiengesellschaft. *Device for removing buckles out of tube walls.* Flugsport, v. 34, no. 1, January 7, 1942, p. 7. 2 p.

2148 *Fan impeller of welded polyvinyl chloride.* Kunststoffe, v. 32, no. 3, March, 1942, p. 91. 2 p.

2149 Heinkel, Ernst, flugzeugwerke. *Underwater wings for assisted take-off.* German patent, no. 726,616. Flugsport, v. 35, no. 5, March 3, 1943, p. 208. 2 p.

2150 Willstätter, R., and Zechmeister, L. *On the hydrolysis of cellulose.* Berichte der Deutschen chemischen gesellschaft, v. 62, Section B, 1929, p. 722–725. 3 p.

2151 Sheviakov, T. *On the question of using unshrouded blades in gas turbines.* Sovetskoe kotloturboestroenie, U.S.S.R., no. 1, January, 1940, p. 30–32. 5 p.

2152 Trutnovsky, K. *Tests on unsteady flow through labyrinths.* Zeitschrift des Vereines deutscher ingenieure, v. 86, no. 39–40, October 3, 1942, p. 609–611. 5 p.

2153 Meyer-Rässler, E. *Aluminium piston alloy KAI 3212/13 (Mahle 124H) containing only .5% Cu and .5% Ni.* Aluminium, no. 4, April, 1943, p. 165–171. 12 p.

2154 *Development in piston design.* Aluminium, no. 4, April, 1943, p. 171–174. 6 p.

2155 Bruder, E. *A machine for the production of synchronous combined flexural-torsional fatigue stresses.* Zeitschrift des Vereines deutscher ingenieure, v. 87, no. 5–6, February 6, 1943, p. 82. 2 p.

2156 Askania-werke a.-g. *Pneumatic relay for pilotless aircraft.* German patent, no. 725,771. Flugsport, v. 35, no. 6, March 17, 1943, Patent collection, no. 1, p. 3. 3 p.

2157 Schmidt, R., and Klein, H. *Two new dynamic extensometers.* Luftwissen, v. 9, no. 11, November, 1942, p. 313–316. 6 p.

2158 Hollbach, O. *Diesel engines in aircraft.* Luftwissen, v. 10, no. 3, March, 1943, p. 77–79. 3 p.

2159 Ulrich, M. *Increasing the fatigue strength of gear wheels by special shaping, hardening and machining of the tooth base.* Luftwissen, v. 9, no. 11, November, 1942, p. 311–312. 6 p.

2160 Henschel flugzeug-werke a. g. *Arrangement for locking a pivotable tail wheel in its central position.* German patent, no. 732,485. Flugsport, v. 35, no. 10, June 16, 1943, Patent collection, no. 5, p. 33. 2 p.

2161 Fieseler, Gerhard, werke g. m. b. h. *Interconnection of rudder and tail wheel swivel-lock.* German patent, no. 733,683. Flugsport, v. 35, no. 10, June 16, 1943, Patent collection, no. 5, p. 34. 2 p.

2162 Arado flugzeugwerke g. m. b. h. *Improved landing gear incorporating skid and wheel.* German patent, no. 732,486. Flugsport, v. 35, no. 10, June 16, 1943, Patent collection, no. 5, p. 34. 2 p.

2163 Dornier-werke g. m. b. h. *Aerodynamic tail brake.* German patent, no. 730,606, Flugsport, v. 35, no. 10, June 16, 1943, Patent collection, no. 5, p. 36. 2 p.

2164 Süddeutsche arguswerke. *Snow brake applied to skis.* German patent, no. 731,811. Flugsport, v. 35, no. 10, June 16, 1943, Patent collection, no. 5, p. 36. 2 p.

2165 Komelkov, V. S. *An investigation on impulse spark discharge. Part 1.* Zhurnal tekhnicheskoi fiziki, U.S.S.R., v. 10, no. 17, 1940, p. 1426–1433. 9 p.

2166 Heinkel, Ernst, flugzeugwerke. *Fowler flap with aileron action.* German patent, no. 732,917. Flugsport, v. 35, no. 9, May 19, 1943, p. 23. 1 p.

2167 Heinkel, Ernst, flugzeugwerke. *Variable camber flap control.* German patent, no. 732,918. Flugsport, v. 35, no. 9, May 19, 1943, p. 23. 1 p.

2168 Heinkel, Ernst, flugzeugwerke. *Sealing plate for flaps capable of aileron action.* German patent, no. 733,493. Flugsport, v. 35, no. 9, May 19, 1943, p. 23. 1 p.

2169 Junkers flugzeug- und motorenwerke a. g. *Blade root bearing for V.P. airscrews.* German patent, no. 727,968. Flugsport, v. 35, no. 3, February 3, 1943, Patent collection, no. 47, p. 189. 3 p.

2170 Forstmann, R. *Automatic oxygen masks without regeneration.* Zeitschrift für das gesamte schiess- und sprengstoffwesen, v. 36, no. 3, March, 1941, p. 63–66. 4 p.

2171 Heinrich, H. *Numerical evaluation of fourth-degree (biquadratic) equations.* Zeitschrift für angewandte mathematik und mechanik, v. 21, no. 5, October, 1941, p. 304–308. 5 p.

2172 Allgemeine elektricitäts-gesellschaft. *Remote control electric ship's steering gear.* Zeitschrift des Vereines deutscher ingenieure, v. 86, no. 43–44, 1942, p. 35, advertisement. 1 p.

2175 Palkov, S., Kargin, V., and Rogovin, Z. *Solubility of cellulose and its ethers. Part 2, Application of the phase rule to solutions of cellulose ethers.* Zhurnal fizicheskoi khimii, U.S.S.R., v. 10, no. 4–5, p. 607–619. 10 p.

2176 Pawlek, F. *Iron-silicon alloys of high initial permeability obtained by special metallurgical treatment.* Archiv für eisenhüttenwesen, v. 16, no. 9, March, 1943, p. 363–366. 6 p.

2177 Schuch, E. *Determination of knock rating* Öl und kohle, no. 40, October 22, 1941, p. 806–808. 5 p.

2178 Witschakowski. *Knock rating of high octane fuels.* Öl und kohle, no. 40, October 22, 1941, p. 801–804. 5 p.

2179 Jantsch, F. *The blending value of fuel components.* Öl und kohle, no. 40, October 22, 1941, p. 799–801. 5 p.

2180 Singer, E. *Development and results of comparative experiments carried out at the Technical fuel testing laboratory at Ludwigshafen-Oppau with C.F.R. and I.G. test engines.* Öl und kohle, no. 40, October 22, 1941, p. 795–799. 10 p.

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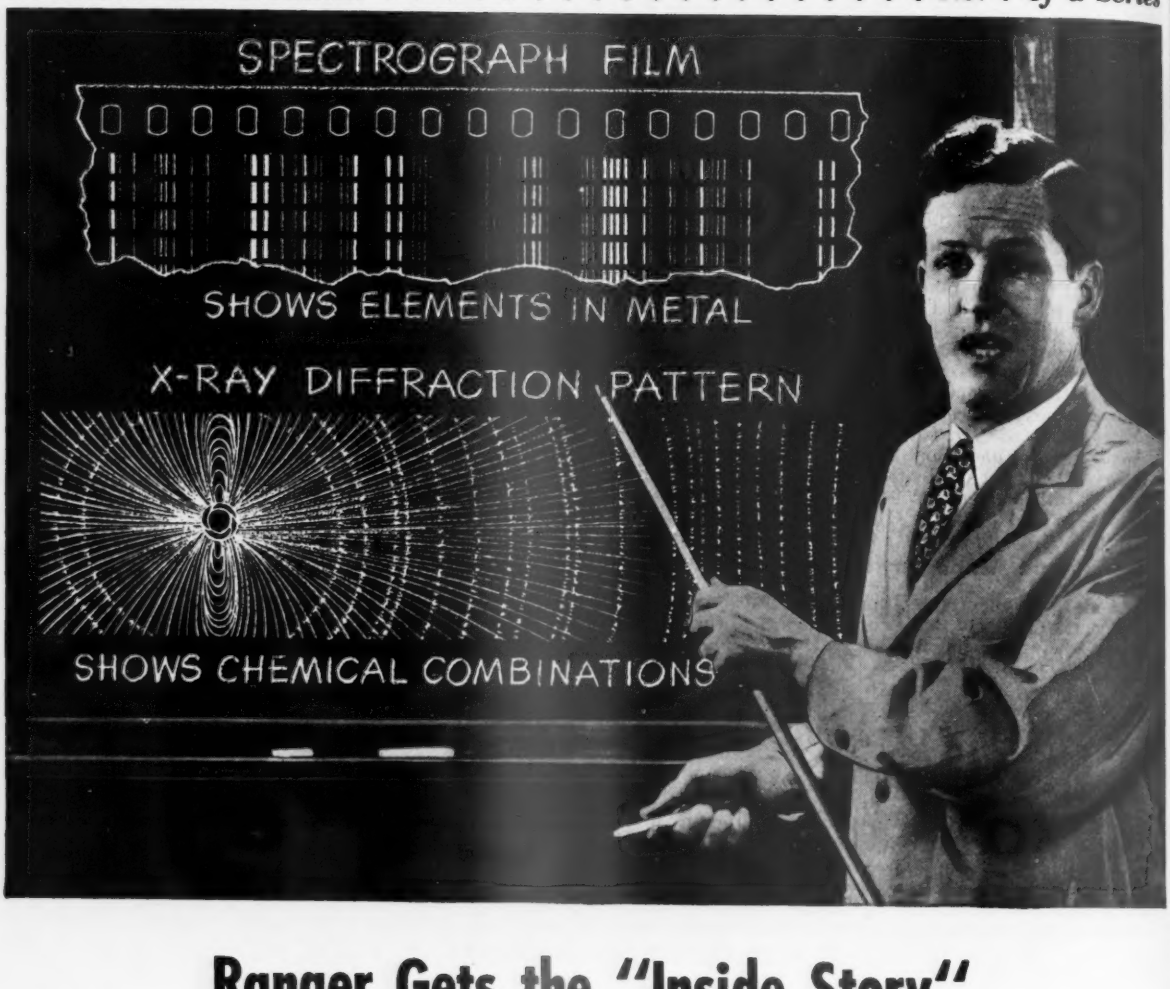

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These patterns tell the inside story of metals.

They are "pictures" taken of the physical and chemical properties of the raw materials which make up parts of the Ranger Sixes and Twelves.

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By using another X-ray technique, Ranger technicians can examine the chemical bond between aluminum fins and the steel cores of Ranger cylinders. In the metallurgical laboratories, technicians have found an efficient engine sealing compound; determined standards for synthetic rubbers used in engine construction; unearthed the "whyfors" of metal fatigue.

All this adds up to knowledge. This knowledge, plus the ingenuity of design and dynamic balance, has created in Ranger engines a sleek, efficient source of aircraft power. The kind of power that lends the "touch of tomorrow in the planes of today."

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BOOKS

Man's Fight to Fly

John P. V. Heinmuller

Contents: Famous World-Record Flights: Igor Ivan Sikorsky; Francesco De Pinedo; Richard Evelyn Byrd; Charles Augustus Lindbergh; Clarence D. Chamberlin; Hermann Koehl, James C. Fitzmaurice, and Baron Guenther von Huenefeld; Amelia Earhart; John Henry Mears and Charles B. D. Collyer; Wiley Post and Harold Gatty; Russel Norton Boardman and John Lewis Polando; Clyde E. Pangborn and Hugh Herndon, Jr.; James Mattern and Bennett Griffin; James Allan Mollison and Amy Johnson Mollison; Paul Codos and Maurice Rossi; Henry T. (Dick) Merrill and Jack Lambie; Howard Hughes. Chronology: Leonardo da Vinci to Richard Archbold.

This book presents historical aeronautics in a new way. The author, who has been Chief Timer of the National Aeronautic Association for many years, knew the men who made famous world-record flights. His knowledge of them and their goals puts him in a unique position to make these historic flights interesting even at this late date. Reproductions from his notable collection of air-mail stamps and covers add to an understanding of the value of the flights.

In the section devoted to the chronology of aviation there are 251 thumbnail sketches of the men who have made aeronautical history both in this country and in Europe. Each sketch is illustrated by a picture of the man and the device for which he was famous.

The whole presentation represents research of a high order and will be helpful to those who are interested in the beginnings and successes of man's conquest of the air. Funk & Wagnalls Company, New York, 1944; 366 pages, $6.00.

Keep the Peace Through Air Power

Allan A. Michie

Contents: Air Power: The Sword of Justice; Germany is Already Preparing Her Third World War; Our Real German Enemies; Militarism Allies with Hitler; The Guilt of the German People; How Germany Won the Last Peace; Germany Rearms; We Must Keep This Peace by Force; What Kind of Force?; Air Control without Occupation; The Air Police Force in Action; Japan—The Germany of the Far East; Air Policing an Interim Solution.

This is one of the most interesting books dealing with postwar problems. The author lays a foundation for his main thesis by reviewing the history of the relationship of the Allies with the Germans after the previous war. He devotes the first seven chapters of the book to an indictment of the militarists in Germany. It is his belief that the German people are as responsible for the warlike aspirations of Germany as the Junkers, the German General Staff, and the political leaders who took advantage of the hatreds generated by the Versailles treaty. He shows how Germany won the peace following the first World War through the lack of willingness of the United States and Great Britain to enforce the treaty's provisions.

To demonstrate how air power can be used to pacify countries, a detailed description is given of the use of the R.A.F. in India, Iraq, Arabia, and Palestine. With this as an example of how huge military expenditures can be avoided and how fewer lives will be lost, the book gives strong arguments for the employment of air power as an international police force for the postwar control of Germany and Japan. The author believes that air control can be maintained without occupation and that naval blockade will not be effective.

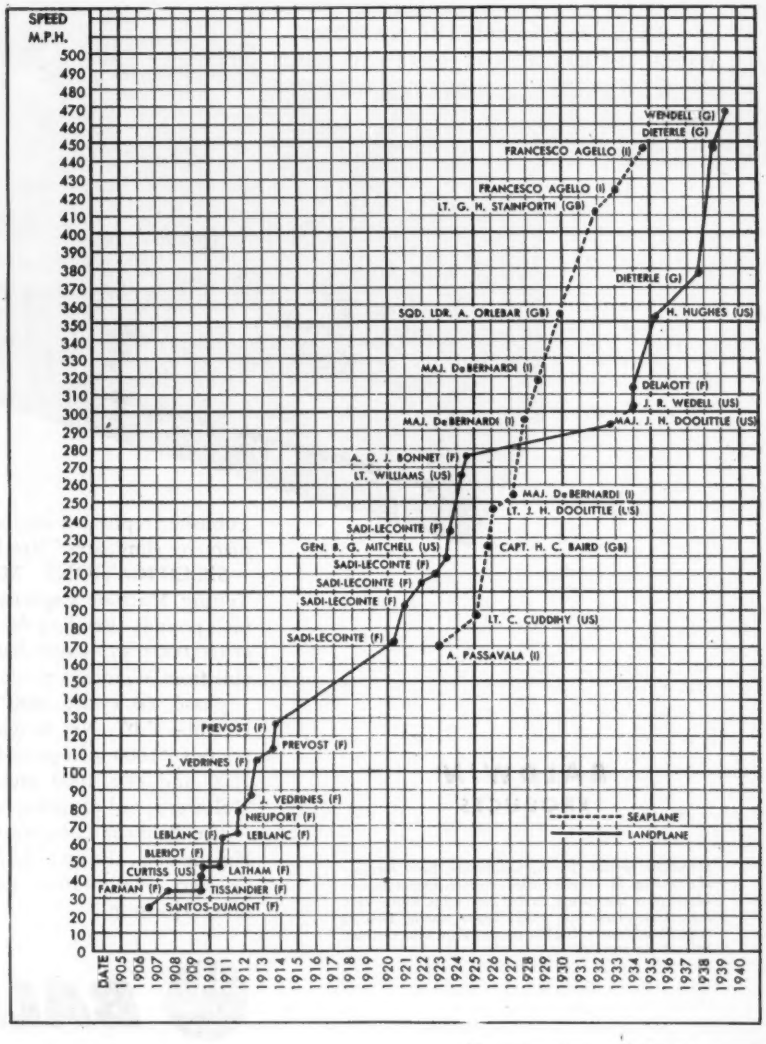

Illustration Courtesy National Aeronautics

World Speed Records. This chart was especially prepared for Mr. John P. V. Heinmuller to show how aviation development can be traced in the official records of the Federation Aeronautique Internationale.

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Published reports of studies indicate that specimens of 1" minimum diameter eliminates "Size-Effect" in fatigue.

SPECIFICATIONS: Model SF-10 R Rotating Beam Fatigue Testing Machine Capacity: 0-10,000* inch-pounds by units of 5-inch-pounds (Bending Moment). Specimen size: Diameter—1 inch at 100,000 p.s.i. (larger diameters of lower stresses). Length—adjustable from 3½ inches to 9½ inches. Motor drive—1½ H.P., 220 volt, 3 phase, 60 cycle, 3600** RPM. Length—6'-3". Width—1'-10". Height—4'-0". Net weight—1500 pounds. *Shipping* weight—1900 pounds. *1000 inch-pounds on beam. Additional capacities by four 2000 and one 1000 inch-pounds weights hung on beam end. **Slower speed or multiple speed motors as ordered.

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TESTING EQUIPMENT

Through the use of air power the collective responsibility of an entire community can be secured. Since the penalties will not be dealt solely to those who attempt to evade the terms of any postwar treaty, it should keep the people themselves from supporting any movement toward aggression.

The plan is not new, having been proposed by many others during the last 20 years. However, Mr. Michie's proposal is presented in such a convincing way and with so many background facts that it will reopen a consideration of these methods for control of our enemies after the war. Henry Holt and Company, New York, 1944; 196 pages, $2.00.

Bombing Vindicated

J. M. Spaight

Contents: The Bomber Saves Civilization; Tactics and Strategics; Our Great Decision; The Battle-Towns; The Bombing of Civilians; The Tokyo Outrage; Retrospect and Prospect.

The ethics of bombing has always been widely discussed. This well-informed writer on aeronautics has given possibly the best argument justifying bombing that has yet appeared. He takes each German argument and tears it to bits. He does the same with the clerical opposition.

He makes the bold claim that, instead of destroying civilization, the bomber will save it. He analyzes the German raids on Norway and England, the English bombing of Germany, and the United States' attack on Tokyo, and from the analysis reaches the conclusion that the bomber has rehabilitated itself and will save the Allied armies from prolonged war. Geoffrey Bles, London, 1944; 159 pages, 6*s*.

The Extrusion of Metals

Claude E. Pearson

Contents: Historical Survey; The Extrusion of Lead and Other Soft Metals; The Extrusion of Lead Cable-Sheathing; Equipment for the Hot Extrusion of Hard Metals; Flow in Metals during Extrusion; The Pressure of Extrusion; Metals and Alloys for Hot Extrusion; The Properties of Extruded Metals; The Impact Methods of Extrusion; Some Special Applications of Extrusion.

Because data relating to the extrusion of metals have been widely dispersed and practice in extrusion has tended to diverge in meeting special requirements of different materials, it has been difficult to obtain a collective view of the subject. In this volume the author has brought together and compared information and data regarding the extrusion of metals, particularly the extensive development achieved during the past 30 years.

The historical development of the process is outlined in the first chapter. To avoid offering a mere description of plants and procedures, the author has attempted to introduce theoretical aspects where possible. Chapters have been included dealing with flow phenomena in the process and with factors such as temperature and the speed and extent of deformation, in their influence on the extrusion of metals. Since the subject of impact extrusion tends to fall into a class by itself, it is given separate treatment. John Wiley & Sons, Inc., New York, 1944; 205 pages, $3.75.

With the exception of aeronautical annuals and books published outside the United States, books reviewed in this section may be borrowed without charge from The Paul Kollsman Library of the Institute of the Aeronautical Sciences, 1505 RCA Building West, 30 Rockefeller Plaza, New York 20, N. Y.

Plastic Horizons

B. H. Weil and Victor J. Anhorn

Contents: What Are Plastics; Plastics and Our Modern World; Plastics in a World at War; Synthetic Fibers and Synthetic Rubbers; Plastics and the Future; Names, Chemical Types, and Manufacturers of Familiar Plastics and Related Materials.

In writing this volume about plastics, the authors' aim has been to present a general coverage of the subject, sufficiently nontechnical for the general public, yet detailed enough to be informative. Without emphasizing details, scientific relationships are explained. Plastics for the equipment of the armed forces, including aircraft, are described.

Included in the book are instructive charts showing the derivation of resins and plastics from coal and other materials, as well as information about some present and potential plastics made from petroleum, plastic parts on airplanes, applications of transparent plastic enclosures on aircraft, and transparent materials and their present aircraft uses. The Jaques Cattell Press, Lancaster, Pa., 1944; 169 pages, $2.50.

Book Notes

Pastoral, by Nevil Shute; William Morrow and Company, Inc., New York, 1944; 246 pages, $2.50.

The author, who is a most successful novelist, is an aeronautical engineer and a Lieutenant Commander in the British Navy. His earlier books, "Kindling," "Landfall," and "Pied Piper," have brought him fame. His latest novel centers around a romance at an R.A.F. station near Oxford. It has a war background, of course but it is subordinated to romance amid the beauty of the English countryside.

The novel gives an intimate idea of life at a station where young women are engaged in the work of the control tower and have close association with pilots and their crews. The book is one of the best stories of the war and worthy of the reputation of Nevil Shute as a brilliant writer, as well as an accurate portrayer of the lives and romances of pilots.

The Pacific World, edited by Fairfield Osborn; W. W. Norton & Company, Inc., New York, 1944; 219 pages, $3.00.

In these days, when eyes are turned to the Pacific and an acquaintance with this area is essential to an understanding of the war's progress to its end, this book edited by an expert will be found to be exceptionally useful. The information presented was gathered by the men of nine educational and scientific institutions. It will give those in our armed services and their families a clearer idea of this great oceanic area.

It is a geography, an anthropology, and a gazetteer. It will acquaint the reader with the meteorologic, zoological, and agricultural facts of the islands and borderlands of the ocean.

"Griff" on the Gremlin, by D. J. Marshall and F. V. G. Royce; The Pilot Press, Ltd., London, 1943; 64 pages, 3*s*. 6*d*.

The Gremlin is portrayed in verse and picture by men with a good sense of humor. The antics of this enemy of all airmen will in this particular instance give pleasure instead of worry.

Find, Fix and Strike; The Work of the Fleet Air Arm, by Terence Horsley; Eyre and Spottiswoode, London, 1943; 143 pages, 9*s*.

There has been so little written about the Fleet Air Arm of the British Navy that this book will give much new information about the organization and action of this new air force.

For many years the British Navy lagged behind in its aircraft development, but when it took over its own service in 1939 it began to use air power in connection with its naval actions in a most creditable way.

The author has portrayed the work of the Fleet Air Arm from all points of view. He describes the carriers and their operation and gives an idea of the training of pilots and crews. Then he turns to the operation of aircraft in the different war zones and shows what a remarkable record naval airmen have made. There is also an excellent evaluation of the aircraft that have been used by the British Navy.

Lanz Aviation Dictionary in Nine Languages, by John E. Lanz; P. D. and Ione Perkins, California, 1944; 430 pages, $6.50.

Each new aviation dictionary has its special advantages. This excellent work combines several. It gives definitions of terms and words and then gives their translations in Spanish, Portuguese, French, Italian, German, Russian, Chinese, and Japanese. The definitions, which are easily understood, include only that technical terminology which is necessary to define the terms clearly and accurately.

In addition to the dictionary section, there are a pronouncing guide to the nine languages, charts for meteorologists, and many tables, all of which add to the utility of the work.

As a research effort of the most commendable kind, it will be useful to the services and industry as well as to the public.

Man's Conquest of the Air, by Harry Harper; John Gifford Limited, London, 1942; 206 pages, 2*s*. 6*d*.

The dean of British aeronautical correspondents, who has had the good fortune to know almost all the pioneers in flying, has written a history of aviation that tries to cut through a mass of details and give the essential outstanding events that have brought the airplane to its present state of development.

He overemphasizes, as is only natural, the contributions made by some of the Englishmen who foresaw the flying machine but who did not have the clue to making it practicable. To the Wright brothers he gives the fullest credit and praise but does not trace the early work of the French pioneers to the information given to them by Octave Chanute.

The most valuable portions of the book are the personal sidelights on the early days of aviation as seen by an eyewitness and friend of many of those who made aeronautical history. It is a book that will add to the lore of the air and preserve memories that would otherwise not be recorded.

An Aeronautical Dictionary in French and English, compiled by technicians of the Free French Air Force; George G. Harrap & Company, Ltd., London, 1943; 1 volume, 10*s*. 6*d*.

Of dictionaries there can never be too many. This French-English compilation will be found to be especially useful in countries where the French are cooperating. It is, however, not a dictionary in the true sense, since it does not give definitions but merely translations from English to French and vice versa.

The French aviation slang, or "argot," is amusing and adds to the completeness of the work. It is another evidence of the careful workmanship of the French who have excelled in such compilations.

The Guys on the Ground, by Capt. Alfred Friendly; Eagle Books, New York, 1944; 170 pages, $2.50.

Books about heroic deeds by pilots and their crews are many, but the men on the ground—the so-called "grease monkeys"—are unsung in verse or fiction. Their life is prosaic. Although the public hears little of their essential work, the pilots give them full credit for their tiresome grind under every kind of difficulty.

This book glorifies the men in the field of the Air Service Command, which is termed the biggest single business in existence, handling about one-eighth of the nation's total commerce. Called the world's largest commercial enterprise devoted to a specific job, it has more than 200,000 civilian employees in the United States alone and an inventory of more than half a million different kinds of Air Forces' items. Its storage warehouses are equivalent to a building 100 ft. wide and 102 miles long.

The A.S.C. supplies the Army Air Forces wherever they are. It repairs and maintains all the equipment, often under the most difficult conditions Where there are no replacements, they are made from any available material. Sometimes a repaired combat airplane will have the tail from one damaged plane, wings from another, and parts from still others. The job of the mechanics in the field is to keep as many airplane units in service as possible.

This book tells of the many extraordinary feats of repair and conversion in the field. No one will read it without having a high regard for the men who "keep them flying." It is to these men that credit must be given for the fine showing our airmen are making on all fronts.

International Air Transport, by Brig. Gen. Sir Osborne Mance, assisted by J. E. Wheeler; Oxford University Press, London, 1943; 117 pages, 7*s*. 6*d*.

This study of air transport will provide a useful background of air law as developed in the many international conferences. The international regulation of air navigation has become so involved with air-sovereignty problems that no general application has been possible.

The particular problems of public law that have resulted from air navigation are discussed in detail and the international organizations having this field as their province are described. Customs, private air law, international services, air mail, and civil aviation are all given consideration.

Objective conclusions as to the future of air transport and its relationship to collective security are reached in the final portion of the book. The future attitude of States to the legal, technical commercial, and military domains is at the cross-roads; an analysis such as this will afford background material and give a clearer understanding of the many problems to be solved.

REFERENCE BOOKS for AERONAUTICAL ENGINEERS AT REDUCED PRICES

TABLES OF FUNCTIONS With Formulae & Curves by E. Jahnke & F. Emde.
The world's most comprehensive one-volume collection of the transcendental functions with additional 76 pages on elementary functions. Invaluable for practical computations involving the higher functions. Includes Bessel Functions, Sine, Cosine & Log. Integral, Legendre Functions, etc. 400 pp. 200 illus. Orig. pub. at $6.00. $3.50

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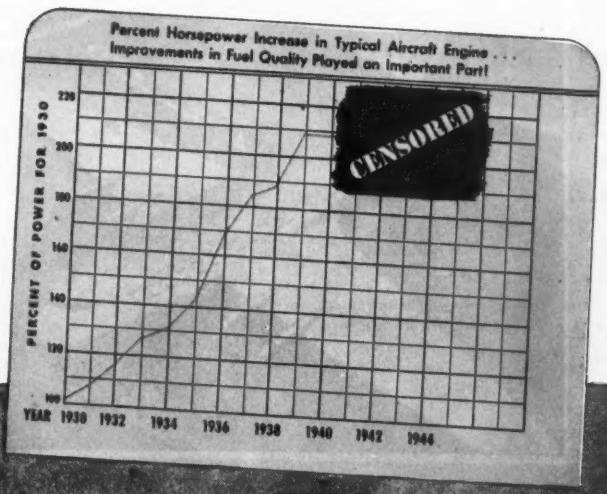

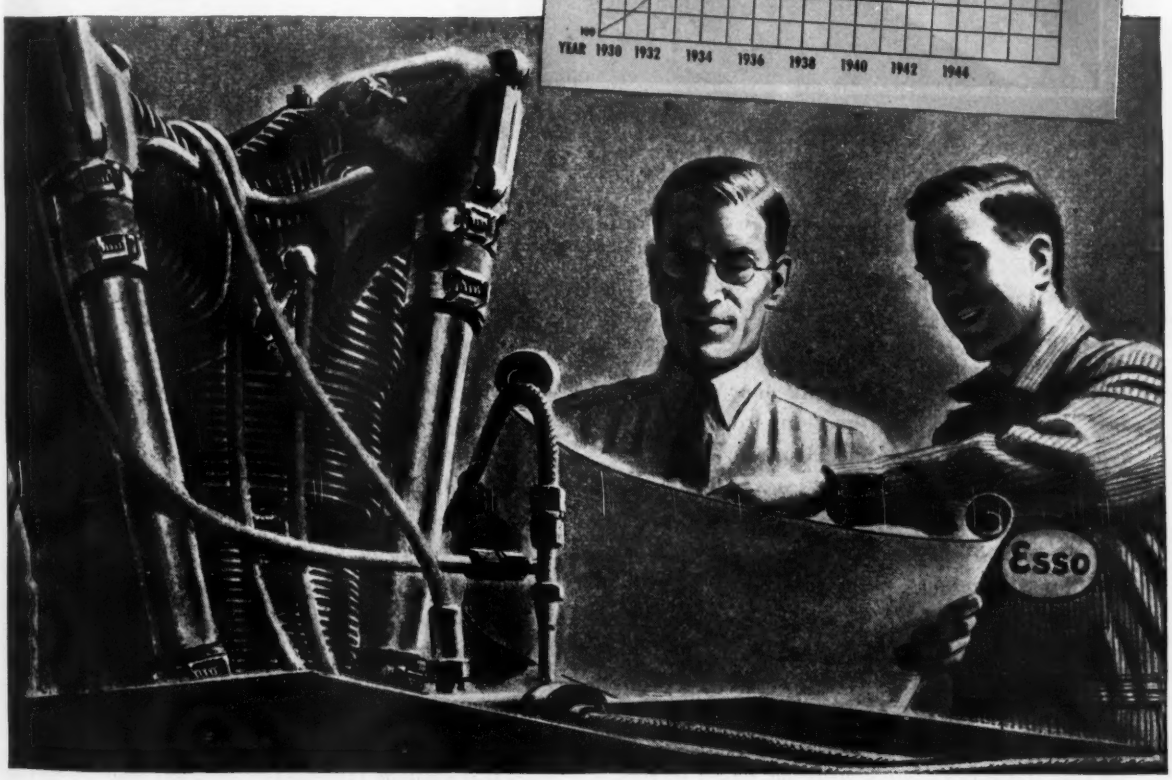

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"BEFORE THE FOURTH YEAR *of peace, we in United Air Lines expect to see domestic air transportation increase fivefold over its best pre-war year, and international air routes making neighbors of all the cities of the earth.*

"But aviation can realize its great expectations for peace and prosperity only if the nation's air lines, which are now out of the subsidy class, can retain their economic independence.

"For wasteful subsidies will not help to insure aviation's further progress. There is no feeling of security while living under subsidy, because ideas about the amount of subsidy vary with each administration and vary with the personality of the people involved. In the long run, all that subsidies can do is clip aviation's wings.

"I believe most men in aviation would agree that we wish to see our business progress 'on its own', receiving revenue on the basis of services performed.

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Believing that the ideas of aviation's leaders are always of interest to the aviation industry, TIME here gives them wider circulation in the name of

AVIATION'S SILENT PARTNERS

TIME

THE READERS OF TIME

A Short History of the Army and Navy, by Fletcher Pratt; The Infantry Journal, Washington, 1944; 262 pages, $0.25.

This book is a concise history of the battles and naval actions of the Revolution and Civil War, with a few pages about internal military troubles and World War I. It will refresh the memories of many whose knowledge of the services has come from school histories and has since become hazy.

Peace, Plenty, and Petroleum, by Benjamin T. Brooks; The Jaques Cattell Press, Lancaster, Pa., 1944; 197 pages, $2.50.

The place of petroleum in the world economy is the principal theme of this book. The demands of war as well as of peace are given. The present situation regarding petroleum supplies is accentuated by the decreasing rate of discovery of new fields.

Oil in world power politics, and some of the difficulties and hazards of foreign oil production are considered, with conclusions about the position of oil in the postwar world.

Mediterranean Air Power and the Second Front, by Air-Commodore A. W. F. Glenny; The Conrad Press, Ltd., London, 1944; 62 pages, 4*s*. 6*d*.

It is not improbable that the use of air power in North Africa will take its place in the history of air warfare as one of the first instances where the airplane was used with maximum success. Air Chief Marshal Tedder's welding of his forces with those of Montgomery defeated Rommel in the turning point of the war.

Air power was used first to blast the enemy's communications, then as a striking power to clear the way for the soldiers, and finally as a protective power.

The author has interpreted the campaign from the point of view of the airman who can brush away the details and present the underlying facts. It is a study in which every student of air strategy and tactics will find sound doctrine.

The Red Air Force, by John Stroud; The Pilot Press, Ltd., London, 1943; 48 pages, 5*s*.

Information regarding aviation development in Russia has been so restricted that it is interesting to find in one book so much data on the airplanes now used by the Soviet Air Force.

The author admits his difficulties in securing complete information but he has nevertheless gathered more than has appeared elsewhere in any one book. His history of Russian aviation, which includes the details of the organization of the Red Air Force and the history of the Russian aircraft and air transport industry, gives a background leading up to the present war.

One phase of aeronautics the Russians have never been backward about making public includes their notable flight records and the work of the men and women who have become world famous because of these exploits. It is interesting to know that what is believed to be the only lighter-than-air service operating at present in the world flies between Moscow and the Urals. The early work of Sikorsky is given in detail. The remarkable records made by gliders and with parachutes are outstanding.

But even more interesting is the description of the 26 aircraft used by the Russians whose details are permitted to be known. Their history, designer, and characteristics are given as completely as possible.

New Naval Phraseology in English, French, Spanish, Italian, German, and Portuguese, by the Department of Foreign Languages, U.S. Naval Academy; U.S. Naval Institute, Annapolis, 1944; 326 pages, $2.00.

The increasing importance of aviation and submarines during the second World War and numerous changes in naval terminology have caused the publication of a new edition of this useful book.

It not only gives translations of English terms in Italian, French, German, Spanish, and Portuguese, but it is a book of naval manners as well. It lists courteous expressions used by naval officers on many occasions and translates them so that they may be expressed in the native tongue of officers speaking other languages.

The section of aviation terms gives in six languages the most frequently used words relating to airplane structures, lighter-than-air, engines, instruments, airports, piloting, aerial combat, meteorology, and equipment.

The colloquies, in the form of conversations in the six languages, acquaint the naval officer with the manners and customs of naval courtesy. A section is devoted to the art of polite correspondence between naval officers of different countries. The table of contents and the index to the naval terms are designed to facilitate reference work. A table of corresponding ranks in various navies concludes this unique and useful handbook.

Gore and Glory; a Story of American Heroism, by Capt. William Crawford, Jr., as told to Ted Saucier; David McKay Company, Philadelphia, 1944; 192 pages, $2.00.

This is a story of continuous aetion in the Pacific, told in a manner to make every page create a feeling of pride in the young airmen in the South Pacific area who are taking every kind of risk to stop the Japanese menace.

Captain Crawford, a pilot who is a veteran of 55 battles with the enemy and of many long-range bombing missions, is credited with sinking three Japanese warships and has won eleven decorations. His record of flying is typical of many of the Army and Navy pilots who risk everything to complete their missions.

Such books are important, not only to the public, but to other pilots who hope for the opportunity of engaging in similar air fights. It is truly a story of American heroism equalled by few.

A Short History of the Royal Air Force, by Ellison Hawks; Real Photographs Company, Ltd., Southport, England; R. P. Publications No. 43/7, 52 pages, 3*s*.

This is a sketch about how the English air forces grew, were put together in the Royal Air Force, and later began to separate again. It contains many interesting photographs.

As a short history of the development of the great R.A.F., it will be useful for those who wish to obtain a general background.

Plane Facts and Features, by Roger Tennant; Argus Press, Ltd., London, 1943; 96 pages, 2*s*.

This pamphlet gives excellent descriptions of the leading fighters, dive bombers, and torpedo bombers used by the American, British, Italian, German, and Japanese air forces in this war. It traces the development of each type and then gives an analysis with silhouette and detailed drawings. It is one of those serviceable pamphlets for use in identification by knowledge rather than by eye alone.

Aircraft Comparisons: Part I, Single-Engined Aircraft, 19 pages, 1*s*. 3*d*.; Part II, Multi-Engined Aircraft, 24 pages, 1*s*. 6*d*.; Real Photographs Company, Ltd., Southport, England, 1943.

These two pamphlets make detailed comparisons between the different types of aircraft most frequently mentioned in the battle areas. Each machine is described and the mark numbers are differentiated. The specifications, performance, and other characteristics of the airplanes are given when permissible.

Wings Over the World; Britain's Vital Stake in Post-War Civil Aviation, by "Indicator"; W. H. Allen & Company, Ltd., London, 1943; 36 pages, 6*d*.

An anonymous but well-informed writer has made a study of air transport and gives his conclusions about postwar problems. Naturally, he takes the point of view of English air transport.

Comparisons are made with rail and steamship transport. The concluding chapter gives excerpts from speeches on the subject by leaders in Parliament.

Polish Wings Over Britain; For Your Freedom and Ours, by L. G. Marsh; MaxLove Publishing Company Limited, London, 1944; 51 pages, 3*s*. 6*d*.

The first Polish airmen came to England for training in 1940. From then until 1943 the Polish Air Force operating with the Royal Air Force increased to 12,000. This pamphlet gives the history of this air force, its personnel, and the exploits of its pilots. Names are omitted for reasons of security.

The group has written one of the most heroic pages in the history of the war and when its full story can be told it will reflect great honor on these exiles who fought for freedom.

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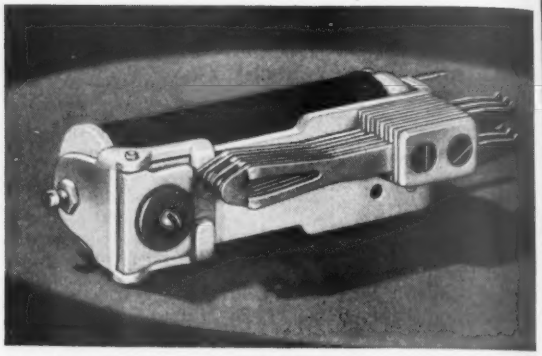

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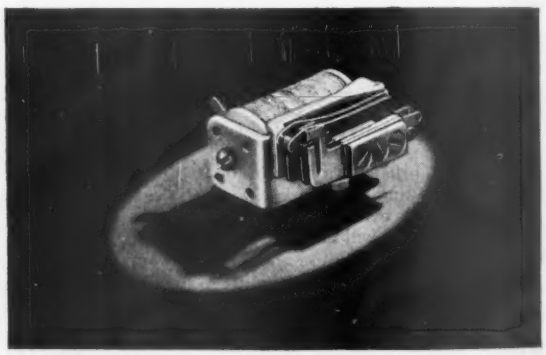

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Camouflage, '14–'18 Aircraft, by O. G. Thetford; The Harborough Publishing Company, Ltd., Leicester, 1943; 77 pages, 3*s.* 6*d.*

The pamphlet is not about camouflage in the usual sense, but is about the color schemes and squadron markings used on military and naval aircraft. It describes the British service markings from 1914, when the first national identification marking was used. From then on each country adopted an insigne by which its airplanes could be distinguished. Soon each squadron adopted some mark of identification. To this the present war has added the naming of individual bombers.

This booklet will be useful in identifying older types of airplanes and will make it easier to single out the aircraft of friend or foe.

British Air Aces, by Lawrence Fairhall; Rolls House Publishing Company, Ltd., London, 1943; 40 pages, 1*s.*

This pamphlet gives short biographical sketches of Nettleton, Campbell, Ward, Edwards, Malcolm, Finucane, Beurling, Malan, Gibson, Learoyd, Nicholson, and Deere. They have all made distinguished records, nine having been given the Victoria Cross.

Aeronautics Illustrated for Service —A.T.C.—Civil Use; Bernards (Publishers) Ltd., London, 1943; 62 pages, 2*s.*

This pamphlet may be called a dictionary without definitions. A thousand or more illustrations give a better idea of aviation terms than ten times as many words. The types of airplanes, power plants, parts, accessories, piloting, airports, and airships all are shown by drawings that give a clear understanding of the term illustrated. It is unique in presentation and its method could be more widely used in books of instruction.

Germany Quivers, by Flight Sgt. Derek R. Lord; A.V.H. Productions, Ltd., Woking, 1943; 79 pages, 2*s.*

A posthumous record of a gallant R.A.F. flight sergeant as shown through a series of letters describing many flights over Europe. It gives a close-up account of numerous bombing missions over the enemy lines.

Meteorology for the Airman, by James Paton; University of London Press, Ltd., London, 1943; 124 pages, 3*s.* 6*d.*

The author finds it necessary to justify the publication of another book on elementary meteorology. He explains that instructors found a need for a small book dealing with elementary physical principles and covering the ground prescribed for R.A.F. service examinations in as concise a form as is consistent with clarity.

The booklet consists of a series of lectures given during a short course in meteorology for officers and members of Edinburgh University Air Squadron. Although it is intended mainly for Air Training Corps and Royal Air Force cadets, it contains information of value to any student commencing a study of meteorology.

Gas Turbines and Jet Propulsion for Aircraft, by G. Geoffrey Smith; Flight Publishing Company, Ltd., London, 1944; 122 pages, 6*s.*

The third edition of this timely book has much additional information regarding this new type of power plant for airplanes.

In addition to the historical section, which describes the many different kinds of reaction-propulsion units, the book devotes much space to a discussion of the jet compared with the propeller and also to the use of jet propulsion as a motive power for propellers. This latter combination, which appears to hold great promise for future development, will be read with interest.

In an added chapter the author describes the use of the air intake and the orifice for the ejection of the jet in connection with boundary-layer control. He describes the use of turbines in the flying-wing type of aircraft, and has added a chapter about turbine-compressor units.

There are biographic sketches of Group Capt. Frank Whittle, who brought jet propulsion to its present practical development; of W. G. Carter, the designer of the Gloster airplane, which first used the Whittle jet-reaction power unit; and of Flight Lt. P. E. G. Sayer, who did the test flying of the Gloster craft.

The book is the standard book on jet propulsion, and as such it will be studied by all who are looking forward to impressive developments of this type of engine.

Morning Flight, by Paul Hutchens; Wm. B. Eerdmans Publishing Company, Grand Rapids, Mich., 1944; 184 pages, $1.25.

Around a flight from Miami to Havana by a missionary to Cuba, the author has written a novel that combines romance, religion, and adventure.

The young woman whose story is told finds solace from family troubles, and tries to put aside her own romantic affairs because of the failure of her childhood sweetheart to agree with her religious convictions. After numerous adventures in Cuba, he becomes converted to her beliefs and the tale ends happily for both.

Over to You: New Broadcasts by the R.A.F., prepared for the Air Ministry by the Ministry of Information; His Majesty's Stationery Office, London, 1943; 112 pages, 9*d.*

This pamphlet was prepared for the Air Ministry by the Ministry of Information. It prints 30 broadcasts by the Royal Air Force, telling of the experiences and exploits of its officers and men in the defense of the homeland and while attacking the enemy.

It recounts incidents in the varied work of R.A.F. pilots and crewmen when combating enemy fighters and bombers, in raids on enemy installations, and in meeting the hazards of getting back to base. A section is devoted to the work of the Ferry Command and of the naval aviation units in flights over the sea. As in many wartime broadcasts, the speaker is anonymous and the exploit about which he speaks is told in the briefest manner. The series, therefore, has a sustained interest and gives a vivid picture of the high adventure of aerial warfare.

The Second Navy Reader, edited by Lt. William Harrison Fetridge; The Bobbs-Merrill Company, New York, 1944; 383 pages, $3.75.

This anthology of Naval activities follows an earlier similar book. It aims to give the public stimulating information about the Navy of their country. Each section is written by an expert in his specialized field.

In the section on Air Power Adm. Ernest J. King writes "Keep Aviation on the Navy's Team." Others write about the successes of the Navy since the attack on Pearl Harbor, the evolution of the Grumman Hellcat, the work of the blimps, how parachutists feel, the operation of a catapult, and the experiences of a carrier pilot.

Summary of British and American Specifications for Non-Ferrous Metals. B.S. 1007: 1942; British Standards Institution, London, 1942; 120 pages, 10*s.* 6*d.*

British and American specifications for nonferrous metals are presented in a collection of tables. It was prepared at the request of the Central Priority Department of the Ministry of Supply. Because the basis on which the specifications have been framed is not identical in Britain and America, it has not been possible to prepare the desired table of equivalents for all cases. As an alternative, tables are incorporated showing the comparative requirements that have been drawn up in the hope that they would provide a means whereby each British department concerned could determine for itself the extent to which it could operate according to American specifications.

Bibliography and Abstracts on Electrical Contacts, prepared by Committee B-4 on Electrical-Heating, Electrical-Resistance, and Electric-Furnace Alloys; American Society for Testing Materials, Philadelphia, 1944; 137 pages, $5.00.

A compilation of references to books, articles, and other publications on electrical-contact materials includes a number of abstracts of the publications cited. The compilation is a result of work carried out by a committee on electric alloys in developing standard methods of evaluating electrical-contact materials and determining the effect of variables upon their performance.

The book is divided into sections designed to make it most convenient for users. The subject index classifies the bibliography in groups of references on separate problems and details involved in the subject of electrical contacts. The author index is for the convenience of those who desire to follow the work of any particular individual. The bibliography and abstracts list is placed in chronological order, based on the year in which the article was published.

Father's Heinkel, by Bernard Wicksteed; Nicholson & Watson, London, 1944; 160 pages, 5*s*.

A civilian pilot who was slightly over service age yields to an urge to fly with the Royal Air Force and transfers from the information section to take a job as an observer. His wife objected to his flying and it was only after he was forced down at sea after a successful attack on a Heinkel that his secret became known to her.

The story tells of the life at R.A.F. stations and concludes with a description of an investiture at Buckingham Palace where the pilot is given a Distinguished Flying Cross by the King.

Baby Flat-Top, by Comdr. Kenneth McCracken; Farrar & Rinehart, Inc., New York, 1944; 180 pages, $2.00.

The book gives an excellent idea of life at sea. There is nothing about battles or attacks, just an amusing account of the men and officers who live together and direct the operation of carriers. It is a book that will delight the friends of the Navy and be good reading for those who man the flat tops.

A Climatic Study of Cloudiness Over Japan, by H. Landsberg; Institute of Meteorology of the University of Chicago Miscellaneous Reports No. 15; The University of Chicago Press, Chicago, 1944; 106 pages, $1.26.

This report was written for the purpose of familiarizing forecasters with certain weather conditions over the main Japanese islands. It is shown that the physical geography of the region, especially the mountains and water surfaces, has important effects on the climate. Sections are devoted to topographical notes, the flow pattern in the Far East, sea-surface conditions, the annual variation of cloudiness, and the daily variation of cloudiness and precipitation occurences. An alphabetical list of stations in the Japanese islands is furnished.

Because of prevailing conditions it was not possible to include a set of typical synoptic maps, and an exhaustive discussion cannot be given for all possible details shown in the various charts. The reader is advised by the author to study the charts carefully for points that are not brought out in the text.

Symposium on the Applications of Synthetic Rubbers, from the Cincinnati Spring Meeting of the American Society for Testing Materials, March 2, 1944; American Society for Testing Materials, Philadelphia, 1944; 134 pages, $1.50.

The purpose of this symposium, developed for A.S.T.M. Committee D-11 on rubber products, is to meet the need for authentic technical information about the use of synthetic rubbers. It contains papers and discussions presented at the spring meeting held at Cincinnati. The papers are divided into two groups, one referring to the origin and development of synthetic rubbers, and the other dealing with specific applications of the material. A large number of charts and tables are included.

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Prompt removal by air to base hospitals is just one reason why the mortality rate among our seriously wounded in this war is only half that of World War I. Over mountains and deserts, over routes that vary from a few miles to hundreds, our winged ambulances carry their precious loads. Until the last wounded man has been brought to the source of the best possible care, they fly on, stopping only to load and unload.

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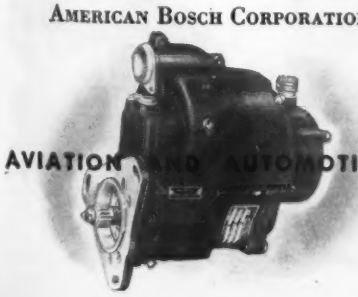

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Airframe Construction and Repair, by John T. Henshaw; Sir Isaac Pitman & Sons, Ltd., London, 1943; 138 pages, 7*s*. 6*d*.

A book written to provide the aircraft mechanic with a knowledge of modern air-frame construction and repair. The text deals with metal stressed-skin aircraft, and has been written as simply as possible without being elementary. Sections deal with air-frame construction, workshop processes, and air-frame repair. A glossary containing many constructional terms is included.

Cloud Cover, by Derek Gilpin Barnes; Rich & Cowan, London, 1943; 176 pages, 12*s*. 6*d*.

Written by an Intelligence Officer of the Royal Air Force, this series of stories about pilots will be read with interest by those who wish to know the attitude of airmen toward their calling.

The author's duties required him to give instructions to the pilots before starting on a mission and to talk with them after they returned from their flights. In the stories of these men he tries to catch their spirit and give an accurate interpretation of their emotional reactions.

Applied D. R. Navigation, by J. H. Cough-Smith; Sir Isaac Pitman & Sons, Ltd., London, 1943; 113 pages, 6*s*.

Practical hints on how to put the theory of dead reckoning navigation into practice are given in this book. It is intended to supplement the standard textbooks by showing how the practices explained in such books are applied to air navigation.

Although this book was written primarily for instructors, in response to requests for a text of this type, it can also be utilized by the student for private study. The examples given in the book have been worked on a Mercator chart of northwest Europe.

"Flight Strips" for Civilian Use, by Col. Stedman Shumway Hanks; American Flight Strips Association, New York, 1944; 28 pages, $1.00.

The purpose of this booklet is to discuss the value and importance of flight strips as a part of the federal, state, county, and city highway system for civil aircraft. How the experience gained from the completed military program for providing such landing facilities should be considered in a postwar civil aviation program is emphasized.

The use of flight strips without discrimination for personal aircraft in private and business flying is urged. The manufacture of special aircraft is recommended for agricultural service.

It is suggested that the deed for the flight strip should have a covenant that no buildings except a small one for the custodians, may be erected on the publicly owned land. Provisions should also be made for easements and air rights of the adjacent private property, title to remain with the private owner. By not acquiring the land, taxes and revenues from the real property are not depleted.

It is recommended that standards be adopted for the construction of flight strips. The use of 5,000-ft., one-runway single, double, and dual flight strips or air strips in America, Canada, Sardinia, Germany, and the Solomons is described.

Climatology of the Mediterranean Area, by Erwin R. Biel; Institute of Meteorology of the University of Chicago Miscellaneous Reports No. 13; The University of Chicago Press, Chicago, 1944; 180 pages, $2.00.

This report was written for wartime purposes to facilitate the instruction in climatology offered to Army and Navy students at the Institute of Meteorology of the University of Chicago. The author has attempted to combine a great variety of climatologic, geographic, and oceanographic facts and to present them in a manner interesting to meteorologists. Conditions affecting the climate in the vicinity of the Mediterranean are dealt with at length. Sections are devoted to pressure and wind, precipitation, water-vapor content and relative humidity, cloudiness and fogs, and temperature. A station list and a bibliography are included.

Achievement in British Aircraft, by S. E. Veale; The Pilot Press Ltd., London, 1943; 37 pages, 2*s*. 6*d*.

This is a well illustrated booklet intended to show one of the great wartime achievements of Great Britain. It is said that aircraft production has become one of the principal industries of the United Kingdom and that probably no industry has ever grown so rapidly in that country.

The chapters tell of the background of the British aircraft industry, tracing the development of the industry from the first World War to the present, and describe some of the prominent British aircraft plants and their products.

Praise is given to the achievements of the Royal Air Force and the Fleet Air Arm. The concluding chapters contain a review of the problems involved in aircraft design, development of British aircraft engines, and a summary of the contributions of the industry to the nation's war effort.

Air Navigation: Part IV: Navigation Instruments, published by authority of and under the supervision of the Aviation Training Division, Office of the Chief of Naval Operations, U.S. Navy; McGraw-Hill Book Company, Inc., New York, 1944; 147 pages, $1.50.

Instruments that are basically necessary to air navigation are dealt with in this manual, which is the fourth of the Air Navigation Series. The instruments described are the basic ones, including those needed to do chart work and make necessary computations in flight; work the triangle of velocity; establish air speed, altitude, and drift; determine headings; take bearings; and observe and identify celestial bodies. The text acquaints the student with the relation of the various devices to the problems involved in arriving at the desired answers.

Physics of the 20th Century, by Pascual Jordan, translated by Eleanor Oshry; Philosophical Library, New York, 1944; 185 pages, $4.00.

In a book reviewing the concepts of modern physics, the author provides an analytic picture of the growth of physics and its relation to cosmic and biologic processes. He reviews the theories of Galileo and Newton with reference to mechanics, which are required for any understanding of the subsequent developments of modern physics. Through a study of Maxwellian theories of electrodynamics, he arrives at the modern views in macrophysics and microphysics of atoms, electrons, and quanta. One of the author's purposes is the gradual removal of misunderstandings of the latest developments in physics on the part of many laymen. Another purpose is to explain how modern physics has brought about changes in the earlier applications of scientific discoveries.

Direction Finding Without Instruments, by Lt. J. A. Shimeld; Angus and Robertson Ltd., London, 1943; 54 pages, 2*s*.

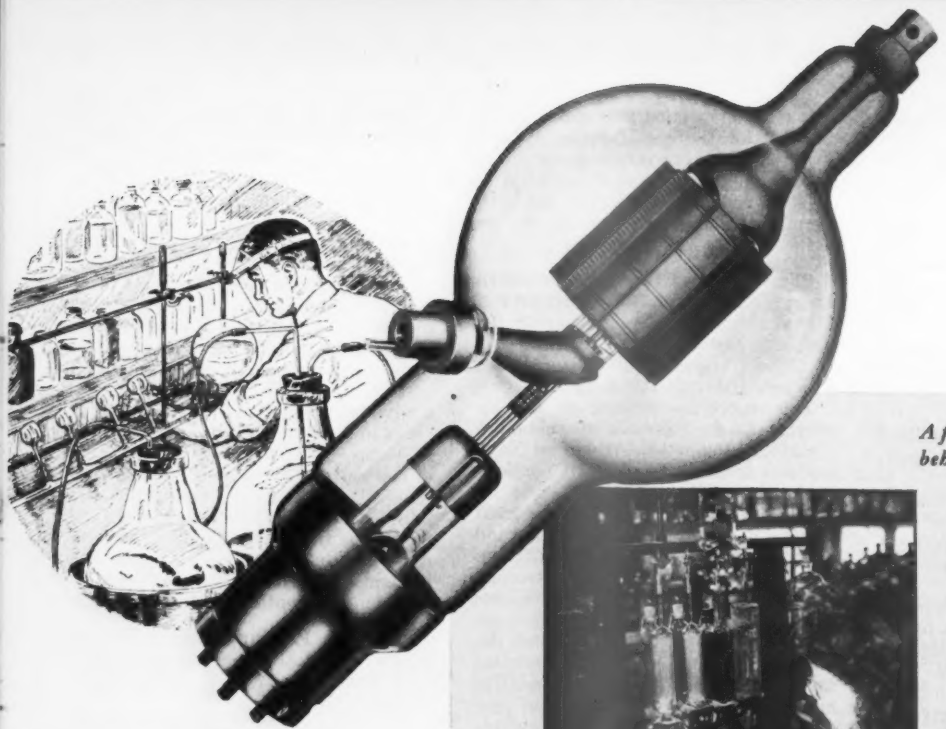
A booklet gives in simple form information regarding the characteristics of the heavens that will enable a person to determine direction from the stars and planets. The actual and apparent motions of the celestial bodies are explained and instructions are given for determining a course and following it accurately. Since the book was written in Australia, the Southern Hemisphere is considered first; instructions are then given with regard to the stars visible from the Northern Hemisphere. One section tells how to determine the time by the stars in either hemisphere, and another section tells how to determine position and direction during the day by the use of the sun.

Approach to Aircraft Recognition, Part II, by J. G. M. Miller and D. M. Harris; Argus Press, Ltd., London, 1943; 38 pages, 9*d*.

This book continues a study of the principles of aircraft identification. Part I was reviewed in the AERONAUTICAL ENGINEERING REVIEW, January, 1944. Information is given regarding the recognition of 65 additional types of airplanes that may be seen flying in England or that are in sufficiently general use elsewhere to make the knowledge of them desirable. Each airplane is shown in three-view silhouette with the chief recognition features summarized. Airplanes that may be confused with the type being studied are listed.

Navigation for Air-Crews, by John E. C. Gliddon and Edward C. Hedges, Part I, 56 pages, 2*s*.; Part II, 161 pages, 3*s*.; University of London Press, Ltd., London, 1943.

A two-part text provides the information required by youths desiring a sound elementary knowledge of air navigation. Part I deals with the form of the earth, latitude and longitude, and magnetic variation. Part II furnishes information about map reading, dead reckoning, the use of instruments, and other navigational subjects.



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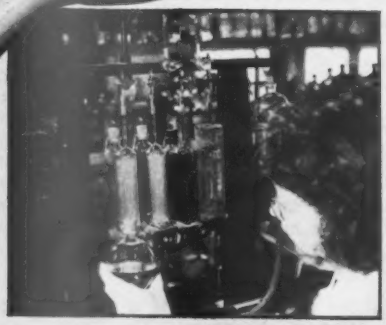

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Principles of Navigation, by Frederick A. Thulin; Navigation Press, Inc., Chicago, 1943; 334 pages, $3.50.

This book was written for young men who are preparing for the Navy or Merchant Marine service and for others who wish to acquire a knowledge of navigation. Sections deal with the compass, latitude, longitude, circles of equal latitude, lines of position, right ascension and sidereal time, surface sailing, and chart sailing.

The book was also prepared with a view toward its use by amateur sailors and yachtsmen, for the study of navigation and nautical astronomy as an avocation rather than as a profession. Therefore, the terms are expressed in their full names or abbreviations instead of in the symbols generally used in such texts. The topical order also has been arranged in a manner to avoid repetitious comments on elementary matters. Such an arrangement is a result of the author's experience in teaching navigation and related subjects.

An Introduction to Principles of Flight, by W. F. Ware; Macmillan and Company, Limited, London, 1943; 158 pages, 3*s*.

An introduction to some of the scientific principles underlying the flight of aircraft. The book has been written for cadets and other students who desire a more systematic approach to the subject than is usually furnished. The subjects discussed include air resistance, lift and drag, control surfaces, flight characteristics, the effects of wind on aircraft in flight, the propeller, and the effects of altitude on flight.

A Report on Synoptic Conditions in the Mediterranean Area, by Staff Members of the Institute of Meteorology; Institute of Meteorology of the University of Chicago Miscellaneous Reports No. 14; The University of Chicago Press, Chicago, 1944; 154 pages, $1.50.

This report was started under an arrangement of the Institute of Meteorology with the former Directorate of Weather of the U.S. Army Air Forces. Its purpose is to show the major weather sequences encountered in the Mediterranean, from the points of view of both the general field of motion and the individual weather elements, to aid in forecasting in the region.

The data used were taken from the publications of all European countries, in order to discuss Mediterranean weather conditions in a manner as clear and detailed as possible. Some of the projects could not be completed because the data were not available. The solution of several problems, such as the cyclogenesis between Tunisia and Sicily, had to be postponed until sufficient upper-air reports are available there. Sections of the report, with their authors, are as follows: "The Air Masses of the Mediterranean," by Lt. E. C. Fowler, Lt. R. A. Bryson, and Lt. H. W. Riebel; "Weather Conditions in the Mediterranean Region during Periods of High Index Over Europe," by Lt. H. N. Smith and Lt. F. D. White; "Effect of the Northwest Flow Pattern on the Mediterranean Weather," by Lt. P. W. Allen; "Effect of the Southwest Flow Pattern on the Mediterranean Weather," by Lt. P. W. Allen; "Special Forecasting Problems of Northern and Central Italy," by Herbert Riehl.

Pocket Manual of Arc Welding; The Industrial Publishing Company, Cleveland, 1943; 128 pages, $0.50.

A pocket manual containing data and information for arc welding operators and supervisors. It was prepared to meet the need for a simple, concise guide to the various phases of arc-welding work for the use of welding instructors, estimators, engineers, and men in supervisory capacities. It is intended to bridge the gap between instruction given to the beginner and the knowledge required by the professional welding engineer. Technical problems involved in distortion, metallurgy, and joint selection are treated in a general way to give basic information, and sources are indicated where more detailed instruction may be obtained.

The Air Navigator's Stars, by L. R. Glegg; Air League of the British Empire, London, 1943; 36 pages, 1*s*.

A guide to the study of the principal stars used in air navigation. A simple explanation is given of their movements in the heavens, and necessary star charts are included.

The first three chapters, reprinted from the *Air Training Corps Gazette*, deal with certain aspects of elementary astronomy and explain in a simple way the reasons underlying the movements of the night sky at different hours and seasons. The fourth chapter discusses a method for charting the stars on a "heavenly map" and the fifth shows how, with the aid of such a map, it is possible to predict the approximate position of stars relative to the observer.

Relevant facts and explanations are given, together with reference to the planets and how to differentiate them from the stars. Circular maps show the northern and southern heavens.

Illustrated Calculations for the A.T.C., by T. H. Ward Hill; George G. Harrap & Company, Ltd., London, 1943; 111 pages, 3*s*.

This book was prepared especially for young men wishing to enter the Royal Air Force who find the ordinary mathematical course difficult to follow. It progresses from elementary arithmetic and emphasizes the application of mathematical calculations to the work of building and maintaining aircraft. Illustrations are used to aid the student in understanding calculations.

Die Mathematischen Hilfsmittel des Physikers (Mathematical Tools for the Physicist), by Erwin Madelung; published and distributed in the public interest by authority of the Alien Property Custodian by Dover Publications, New York, 1943; 384 pages, $3.50.

This is one of the "Yellow Pearl" series of reference books. It contains a collection of approximately 4,000 mathematical formulas used by engineers and other workers in physics, engineering, and pure or applied mathematics. It is intended to be useful particularly to those who deal with the sciences of aeronautics, physical chemistry, electronics, ballistics, and related fields. In addition to serving as a reference book, it is a guide to the fundamental equations and concepts of mathematics and theoretical physics.

It is divided into two sections, the first dealing with mathematics and the second with physics. In the mathematics section there are definitions and essential theorems for the different branches of advanced mathematics, including function theory, algebra, matrices and determinants, series, group theory, differential and integral equations, transformation theory, vector analysis, probability theory, calculus variations, etc.

Section 2 provides a comprehensive collection of the fundamental concepts, definitions, and statements of the basic equations of physics, showing the mathematical applications to specific problems in theoretical physics. Sections refer to the theory of electricity, quantum theory, and classical mechanics. Numerous illustrative examples are given.

1,000 Questions and Answers for A.T.C. Cadets, by Eric De Ville; Hutchinson's Scientific and Technical Publications, London, 1943; 96 pages, 2*s*.

A reference book for Royal Air Force trainees and Air Training Corps cadets. It contains information for air crews in the form of questions and answers. These are intended to provide, as concisely as possible, the necessary background knowledge about the Royal Air Force and its aircraft; principles of flight; and aircraft instruments, engines, and propellers. Chapters about calculations and navigation follow the Proficiency Certificate syllabuses for those subjects. Information is included about the fundamental sciences applicable to aviation, including electricity, heat, light, sound, hydrostatics, and meteorology.

Basic Calculations for R.A.F. Ground Duties (Radio, Wireless, and Electrical Trades), by A. E. Druett; Sir Isaac Pitman & Sons, Ltd., London, 1943; 80 pages, 3*s*. 6*d*.

Prepared primarily for airmen engaged in the radio-telephony, wireless telegraphy, and electrical trades of the Royal Air Force and for Air Training Corps cadets under training for these trades, this book is also intended to help those working for advancement in grades. The author explains how to make the basic calculations required in carrying out ground duties. Adequate provision is made for covering the syllabus in calculations for the Proficiency Examinations.

Practice examples are provided at the end of each chapter; these have been prepared with a view toward their applicability for the trades concerned. Full solutions for the practice examples are given at the end of the book.

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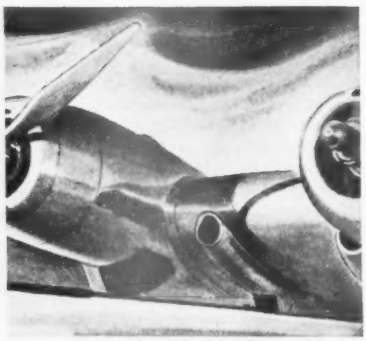

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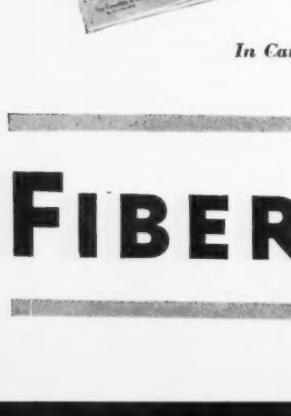

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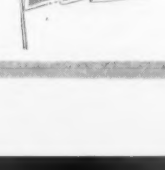

Second Front Aircraft: A Guide to Recognition, by Capt. G. B. Ransford; J. & C. Moores Ltd., Liverpool, 1944; 30 pages, 1*s.* 6*d.*

This guide to the recognition of the slow-flying troop transports and gliders which are being used at the invasion fronts in Europe supplements an earlier book by the same author giving methods for recognition of combat aircraft. The present booklet applies similar methods to the recognition of low-altitude craft for the benefit of observers and ground gunners who must be able to differentiate between friend and foe. The particular identification features of American, British, and German transports, gliders, and glider tows are given in such a way as to be easily memorized.

A First Course in Air Navigation, by F. F. Crossley; Macmillan and Company, Ltd., London, 1943; 85 pages, 2*s.* 6*d.*

In a pocket-sized booklet for flight students the principles of air navigation are described in easy-to-understand language. Beginning with the form of the earth, latitude, longitude, deviation, and bearing, explanations are given of the triangle of velocities, map-reading, position, and projections.

The concluding chapters give instruction about meteorology and aircraft instruments. Problems, exercises, and test papers are assigned, and answers appear at the end of the book, but the author urges the student not to confine himself to these but to work out his own problems in as great a variety as possible. A chart of the principal star groups of the Northern Hemisphere occupies the inside of the back cover.

Air Navigation Plotting, by Mansel Williams; G. Bell and Sons, Ltd., London, 1943; 88 pages, 2*s.* 6*d.*

This practical handbook contains diagrams, exercises, and hints designed to enable the cadet to master the fundamental principles of air navigation. This is the second edition of a text written especially for prospective pilots and observers.

Several minor alterations have been made to bring it up to date and to conform with certain changes being adopted in many R.A.F. schools of navigation in the manner of indicating wind lines and the position of aircraft. The teaching method is based on having the student perform the actual work rather than telling him how to do it.

How to Write and Interpret Orders, Reports, Letters, Memoranda, etc., for the A.T.C. and R.A.F., by T. C. Rising; George G. Harrap & Company, Ltd., London, 1943; 64 pages, 2*s.* 6*d.*

A book for aviation cadets, written for the purpose of giving training in comprehension, expression, and the logical arrangement of information for specific purposes. The course is designed to aid students in examinations as well as to develop clarity and precision of thought, memory, and powers of observation. The explanations, examples, and exercises are based on parts of the A.T.C. and R.A.F. training courses, the subject matter touching upon aircraft recognition, signals, mapping, drill, armament, and law and administration. Instruction is given also in staff work, organization, and leadership. The arrangement is planned for students working singly, in groups of two or three, and for classes working under an instructor.

Reconversion—The Job Ahead, by J. A. Livingston; Public Affairs Pamphlet No. 94, Public Affairs Committee, Inc., New York, 1944; 32 pages, $0.10.

The author gives a personal analysis of reconversion problems. He recognizes that the disposal of government-owned property after the war is a problem to many business men but, while emphasizing the need for the prompt establishment of workable policies to relieve uncertainty, he finds the problem greatly exaggerated. The marketable carryover from war- to peacetime economy is estimated at only $15,000,000,000. In a country capable of producing goods and services at a $175,000,000,000 annual rate, a carryover of this size is held to be entirely manageable.

The real problem is stated to be not so much one of size as of administration. Reconversion is defined as a combination of the work of disposing of surplus property, settling contracts fairly, relaxing restrictive orders with administrative precision, firmly holding the price line, and providing opportunities for employment and the resumption of private enterprise.

Elementary Handbook of Aircraft Engines, by A. W. Judge; Chapman & Hall Ltd., London, 1943; 226 pages, 12*s.* 6*d.*

Written to fill the gap between elementary and more advanced textbooks, this volume deals with the essential aspects of aircraft engines. It is suitable for students, aircraft mechanics, apprentices, air-training cadets specializing in engines, R.A.F. personnel, and others engaged in the aircraft industry. Mathematical aspects of the subject are reduced to a minimum, although an appendix is furnished which gives simple formulas concerned with engine calculations. The author outlines the historical side of the subject, discusses general considerations of modern engine requirements, and explains the working cycles in some detail. He then discusses carburation and supercharging principles and practice. An appreciable amount of space is devoted to descriptions of the more important engine components and to the features of representative engines.

Direction Finding by Sun, Moon and Stars, by W. G. Woolnough; Angus and Robertson Ltd., London, 1943; 158 pages, 3*s.* 6*d.*

In this book information is given which will enable the reader to solve problems of time and direction with reasonable accuracy without the use of complicated mathematical calculations. While intended especially for the layman, the process is elaborated to provide professionals with a convenient and quick method of arriving at results of considerable accuracy without recourse to cumbersome mathematical tables which are not always available when required.

Kenkyusha English-Japanese Dictionary; Commercial and Technical Terms, by Nintaro Fujita; P. D. and Ione Perkins, South Pasadena, Calif., 1944; 1,220 pages, $7.00.

The first part of this English-Japanese dictionary comprises a 1,060-page alphabetical list, translating commercial and technical terms from English into Japanese. It has additional sections containing English and Japanese abbreviations, weights and measures, coinage, Japanese and Western chronology, important cities of the world in English and kanji characters, and a phonetic table. It has numerous illustrations. A Japanese-English index to the volume is furnished.

The author was employed for a number of years by the Japanese firm of Mitsubishi and in recent times, until 1941, he was a Japanese clerk in the commercial department of the British Embassy in Tokyo. His work consisted largely of the translation of commercial and technical matter, and while thus engaged he assembled the material from which this dictionary was compiled. The Japanese edition was first published in August, 1941, and this American edition has been prepared to fill a need resulting from the limited number of Japanese copies reaching this country.

Transport Aircraft of the World, by Lester Ott; Franklin Watts, Inc., New York, 1944; 112 pages, $2.50.

A book containing descriptions and illustrations of the present and prospective passenger and cargo aircraft of the United States, England, Canada, the Soviet Union, Germany, Italy, and France. Included are illustrations of planes now on the drafting boards and of test models. The illustrations comprise photographs, drawings, sectioned sketches, and the so-called perspective views. The text is written in nontechnical language and gives specifications of the different airplanes.

The Airplane Power Plant, by Lt. Col. Francis Pope and Arthur S. Otis; World Book Company, New York, 1944; 188 pages, $1.40.

An elementary text in which the constructional features of aircraft power plants are described in simple language. Sections are concerned with engines, engine accessories, engine efficiency, supercharging, and propellers.

Defensa Pasiva (Antiaircraft Defense), by Juan Gomez Guillamon; "El Ateneo," Buenos Aires, 1942; 191 pages, $1.80.

According to the author's own statement he does not make a claim of originality for this book, since it is a recapitulation of data compiled from various publications and exhibitions. In this way it deals with the entire field of civil air defense, its organization and operation. A lengthy chapter is devoted to the construction of bombproof shelters.

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Spherical Trigonometry with Naval and Military Applications, by Lyman M. Kells, Willis F. Kern, and James R. Bland; McGraw-Hill Book Company, Inc., New York, 1942; 281 pages, $2.40.

Spherical trigonometry is treated in detail and important applications of trigonometry and logarithms to navigation are dealt with in this book. The authors have written the text with a view to the needs of men who expect to become officers in the Navy, Army, or Air Corps. Each topic is explained, illustrated, and followed by a list of problems designed to give familiarity with the topic and call attention to important features. The authors place emphasis on fundamental ideas stripped of confusing details that tend to obscure the underlying principles.

Such subjects as the laws involved in the relative motions of ships, airplanes, and torpedoes, navigation by the plane triangle, middle-latitude sailing, course and distance, and location of position of ships and airplanes are considered in turn. Outlines are given of suggested material for a short course, a medium course, and a complete course of study.

Appendixes contain information regarding the use of the *mil*, the range finder, stereographic projections, and relative movement or maneuvering and mooring-board problems.

Pages containing five-place logarithmic and trigonometric tables are bound at the end of the book.

Aerotécnica Elemental (Elementary Aeronautical Engineering), by Gustavo F. Gerock; Casa Editora Establecimiento Grafico (E.G.L.H.), Buenos Aires, 1939; 192 pages.

This book consists of two parts. The first part contains a history of the airplane and its various types, from the Wright Brothers up to the present, and a discussion of the fundamentals of aerodynamics.

The second part deals with the practical application of aeronautical engineering and with the processes of manufacturing the component parts of the airplane. The chapters are in a condensed form but they give much information about the elements of such broad subjects.

The Air Mariner; A Flying Boat Guide, by D. C. T. Bennett; Sir Isaac Pitman & Sons, Ltd., London, 1943; 128 pages, 7*s*. 6*d*.

This flying-boat guide contains information about the general design of flying boats, marine equipment and moorings, water handling and towing, the characteristics and operation of flying boats, and anchors and anchoring.

It includes definitions of the various parts of the flying boat and of terms comparable to those describing parts in surface vessels. The technique of handling a flying boat on the water is similar to that of handling surface vessels of comparable size, and the ordinary rules of small-boat seamanship are applicable in many ways. The latter part of the book gives instructions for flying this type of aircraft.

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This new Wittek Worm Drive Hose Clamp, approved by the Army Air Forces as meeting specification AN-FF-C-406A, offers distinct advantages to the aviation industry. It is made entirely of stainless steel, combining inherent corrosion resistant properties with greater strength and lighter weight.

The clamp is streamlined and compact in design. The hose clamp band is ½" wide and the clamp only 9/16" in width at its widest point. The screw is fully enclosed in a stainless steel housing, only ½" of which bears on the hose. This scientific design of the housing combines compactness with greater strength, providing excellent sealing characteristics, plus a larger effective range of adjustment to fit variable hose sizes. This, in turn, reduces the necessity for many sizes of clamps.

Since the beginning of modern aviation, Wittek Aviation Hose Clamps have been known as the standard of the industry. Now . . . having successfully solved the tough problem of making a superior worm drive clamp from stainless steel . . . Wittek offers this new clamp as a further contribution to the industry, both for war and peace.

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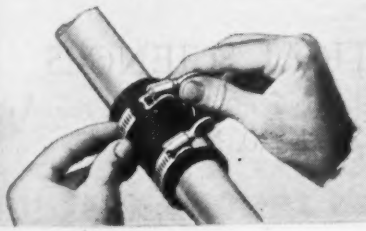

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Aviation HOSE CLAMPS

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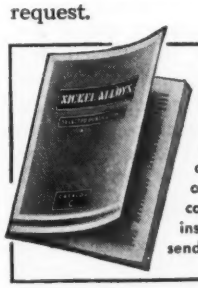
For years the technical staffs of International Nickel have been privileged to cooperate with automotive engineers and production men. Counsel, and printed data about the selection, fabrication and heat treatment of ferrous and non-ferrous metals is available upon request.



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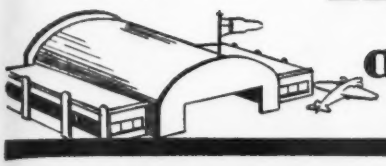

Material for Aircraft Enclosures

A Progress Report on Laminated "Lucite"-"Butacite" Sheeting for Transparent Aircraft Enclosures and Other Uses is a compilation of data assembled to date with regard to this laminate and its applications in aircraft construction.

This new product has been developed to meet specific needs of the Armed Forces. It has been tested cooperatively with the Army and Navy during the last 2 years.

The results of these tests show that pressurized enclosures made from laminated "Lucite"-"Butacite" sheeting do not rupture when subjected to gunfire. The use of this material permits the quick sealing of holes in the plastic which result from bullet or flak fire, thus assisting in the maintenance of internal air pressure necessary for high-altitude flight.

The report describes briefly the advantages of the product and gives details of the tests to which it has been subjected. Its properties are discussed at length. Photographs and charts illustrate the text. *E. I. du Pont de Nemours & Company, Inc.*

Repair Method for Plywood, Wood, and Wood Laminates

Dura-Repair Makes Its Debut. The principles, operation, and advantages of a method for repairing plywood, wood, and wood laminates are detailed. Devised to correct flaws in Duramold planes and equipment, the process is reported to be applicable to all types of wooden components and industrial goods. It is based on the development of pressure internally and directly across the repair joint by means of a vacuum-sealed, contouring membrane. It eliminates the need of rigid external bracing and provides the mechanic with one simple flexible tool that fits itself to any shape or form. Among the specific kinds of Dura repairs which the article describes are those to restore a scarf type of joint, a completely damaged area of a shell, and a damaged area that does not extend entirely through a shell. Particulars are also given on the tools utilized in the Dura-repair technique. *The Pegasus*, August, 1944.

Extruded Parts Data

The Process of Extruding. Comprehensive data for industrial engineers and designers about the process of extruding and products that can be made thereby from natural, synthetic, and reclaimed rubber and from plastics are contained in a new 12-page illustrated catalogue. The booklet describes the requirements for correct compounding and accurate die-making.

Round, square, and rectangular shapes and tubing are among the most common shapes of extruded parts. Skilled die-making, however, can produce parts in extremely complicated and intricate shapes.

The catalogue also tells how two different materials can be extruded together to produce a reinforced part, such as a rubber-coated Masonite strip used in refrigerators or a piece of sponge rubber cord extruded with a smooth rubber coating on all sides to form a tubular gasket of high compressibility and low permanent set. It also tells how cork can be introduced into rubber compounds for the extrusion of light, flexible insulation tubing. Manufacturing limitations—how hard or soft the stock may be and size limits of various shapes—are also given. The booklet was prepared for those who may be faced with the problem of designing or specifying natural or synthetic rubber or plastic parts of industrial products and equipment. *The B. F. Goodrich Company.*

Industrial Science Increases Engine Performance

War Yields New Stamina for Engines. H. A. Hershfield, Jr. An account is given of how aircraft engines in general and Ranger engines in particular have been improved during the war years through scientific analysis. The contributions of industrial laboratories, production engineering, and quality control to the development of aircraft engines are noted. To indicate the improvements achieved, typical performance figures of Ranger engines at the beginning of the war are compared with current performance figures. *The Pegasus*, August, 1944.

Seagoing Liberator Pilots

Making Liberator Experts for the Navy. This article tells how naval air crews are trained in Liberator operation at Camp Kearney. It is reported that the flight-training program is carried out by commissioned naval instructors, while ground-school work is taught by civilian instructors from Consolidated Vultee Aircraft Corporation's Industrial Training Division. With particular reference to the Navy PB4Y, subjects taught include pilot instruction, radio, ordnance, automatic pilot, hydraulics, oxygen system, control systems, electricity, engine mechanics, and structures. *Plane Talk*, July, 1944.

Air Power and World Trade

Pax Aeronautica. John W. Donaldson. The title of this brochure is suggested by what the writer considers a new era in world history, comparable with two great periods of peace in the past: the *Pax Romana* of the Antonine Caesars and the *Pax Britannica* which followed the Napoleonic wars. The writer suggests that another great era of peace will follow the present war, which might well be known as *Pax Aeronautica*. It compares the air power of the present day with the military power of the Roman Empire and that of the British Empire in the previous periods but accentuates the belief that the era to come is likely to be based on a growth of world commerce resulting from the use of aircraft.

Statistics and charts give information about the volume of world production and trade, the exports of various countries, and the effects of numerous attempts at international agreements in connection with the development of world trade. *J. Henry Schroder Banking Corporation and Schroder Trust Company*, New York.

Storage-Battery Welding

The How and Why of Storage Battery Welding has been published in an effort to provide detailed answers in print to the most commonly asked questions about the new process of welding with storage batteries as a power source. Some 35 major questions relating to costs, operation, maintenance, design, installation, etc., of "battery" welding equipment as developed for the various forms of resistance welding are answered in this 12-page illustrated booklet.

According to the booklet, the new battery welders can be effectively used on any material capable of being resistance-welded, including aluminum, stainless steels, alloy steels, carbon steels, brasses, etc. Each welder unit, being completely self-contained, can be made portable and moved about in a factory. In most cases, a maximum of 10 to 20 amp. or less from a 220- or 440-volt line is all that is required to keep batteries charged under service conditions. It is claimed that battery-operated welders represent the simplest form of resistance-welding equipment available. *Progressive Welder Company*, Detroit.

New Regulator Bulletin

Fine Regulators for Welding and Cutting is a new bulletin illustrating the design and construction features of cer-

LIFTING *DRY* SAND IS NO FUN!

A 100 pound bag of *dry* sand is heavy enough. But soaked with water, it weighs *125 pounds* and is that much harder to lift.

Resilient parts of a plane—gaskets, packing, seals, hose, accumulator bags, diaphragms—may also take on additional weight—*by absorbing petroleum products* with which they are constantly in contact! Not included in the original design, this dead weight handicaps plane performance—reduces speed—lessens pay load. Swelling of liners may decrease capacity of hose, accumulator bags, or other similar parts.

Hycar synthetic rubber *licks* both of these problems. Light in weight to begin with, Hycar's superb resistance to oil absorption *keeps* it light—provides protection against increased weight and decreased capacity offered by no other comparable material.

15% to 25% lighter than many other synthetic rubbers
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All highly important qualities in aircraft applications!

You need these properties in resilient materials used in *the* presence of oil and gasoline. Let our Technical Service Staff help you solve your individual problems. *Hycar Chemical Company, Akron 8, Ohio.*

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Synthetic Rubber

Correct pronunciations and meanings of commonly used synthetic rubber names and terms are given in the new pocket-size Hycar Glossary. Write for free copy.

tain types of Victor single and two-stage reduction regulators employed in the welding industry.

It discloses design and construction details and contains brief specifications and page-size illustrations showing the internal construction of the different models. *Victor Equipment Company*, San Francisco.

Pilot-Light Data Book

Gothard Pilot Light Assemblies for Panel Board and Instrument Signaling contains 24 pages of illustrations, diagrams, specifications, prices, and other pertinent information about such products. It gives data regarding pilot light models for a wide range of applications and voltages, including variable intensity and fixed types. Lamps, brackets, and accessories also are illustrated and described. *Gothard Manufacturing Company*, Springfield, Ill.

Harness Band Data

A supplement to the manufacturer's catalogue of wire harness bands with resilient linings shows an attaching clip. The device is intended to insure a positive installation that cannot be accidentally pulled off the structural member once it is fastened in place.

The new type L harness band is supplied at present with two different mounting clips, affording a means of making a positive assembly on bulkhead, lightening hole, or other framework. *United-Carr Fastener Corporation, Aircraft Parts Division*, Cambridge, Mass.

Addition to Aircraft Products Catalogue

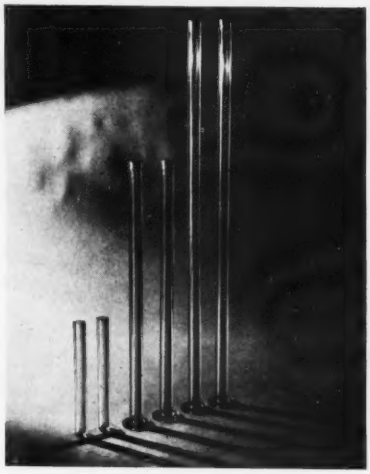
A new Mechanical Goods Section (pages 1–9A) has been issued for the Aircraft Products Catalogue published by the U. S. Rubber Company. This section supersedes pages 1 through 9 of the previous Mechanical Goods Section. The list of products it refers to includes bullet-sealing, fuel, oil, and coolant, flame-retardant, flexible hydraulic, and air-duct hose; air ducts; and flexible duct connectors. *United States Rubber Company.*

Magnetic Drain Plugs

A folder reveals the advantages of magnetic drain plugs for use in gear cases, bearing housings, transmissions, pumps, etc., where moving parts operate in a bath of oil. The purpose of the plugs is to trap abrasive metal particles that cause wear and other damage. It is stated that the plugs retain their magnetism for years. The folder illustrates some of their applications. *Lisle Corporation*, Clarinda, Iowa.

Electric Actuators

A folder describes electric actuators for providing the torque necessary to perform such functions as retraction and lowering landing gear, opening and closing bomb bay doors, and adjusting wing flaps. The electric actuator installations comprise a reversible motor unit, designed for the particular operation to be performed; a suitable solenoid switch for each direction of motor rotation; a selector switch on the control panel; and limit switches. Included in the folder is a specification chart. *Eclipse-Pioneer Division, Bendix Aviation Corporation.*



Transparent, nonshattering plastic fuel gauges made of either Lumarith or Celluloid come in a variety of thicknesses and lengths and are used in planes, tanks, amphibia, and on many types of war and industrial machinery to indicate the supply fuel on hand. Severe impact does not break them.

Magnesium Foundry for Engine Parts

Foundry for Featherweight. This article is about the magnesium foundry of Wright Aeronautical Corporation's Cincinnati Plant. It describes the system of mechanized production lines by which lightweight engine parts are manufactured at this foundry, describes the functions of the various foundry departments, and notes special procedures that are peculiar to the operations of this particular magnesium foundry. *Trade Winds*, July, 1944.

Fatigue-Testing Machines

A 4-page bulletin, designated as No. 610, describes a line of vibration-fatigue-testing machines and features a new model 10HA. It is stated that the new model meets all requirements for a fatigue-testing machine that will subject parts up to 10 lbs. in weight to vibrations produced horizontally in simple harmonic motion. It has a range from 10 to 55 cycles per sec. (600 to 3,300 vibrations per min.). The vibrations are increased and decreased automatically at a uniform rate. *American Tool and Manufacturing Company*, Chicago.

Aviation Catalogue and Handbook

Weatherhead Aviation Catalog No. A 300 B is a 166-page, two-color handbook. It includes sections on AN Fittings, AAF 811 Fittings, Aircraft Hose and Hose Assemblies, Valves and Hydraulic Cylinders, and a compilation of useful engineering data.

An entire page is devoted to each item, with a photograph, drawings, basic dimensional details, and other information supplied for each. Specifications on material, finish, coloring, marking, and threads also are included.

Thumb tab indexes make the new Weatherhead handbook easy to use. Bound in loose-leaf fashion, the material can readily be kept up to date with replacement and revision sheets, which, it is indicated, will be issued as the need arises.

Bound in the handbook is also a series of Weatherhead AN-AC-NAF Conversion Charts, comparing Army Air Forces and Naval Aircraft Factory fittings to facilitate substitution or replacement. *The Weatherhead Company*, Cleveland.

Aircraft Timber Booklet

Selecting Aircraft Timber. Tom Clark. This booklet contains a discussion of the technical aspects of the properties of timber suitable for aircraft use. It is based on notes accumulated by the writer as a result of his experiences of many years in the selection of materials for aircraft purposes. After referring to publications of the Canadian Forestry Commission, the writer describes the origin of Sitka Spruce, the characteristics making it suitable for aircraft use, and methods for preparing it for that purpose. Methods and formulas for determining the moisture content of timber are given, with information about the apparatus used in testing it. Processes for inspecting timber and detecting flaws are discussed, with particular attention to the grain and the properties found in the different grain structures. *de Havilland Aircraft Company, Ltd.*

Oil Resources

Oil for the World is a 16-page booklet containing a discussion of the oil resources of the world, a world oil policy, and the importance of oil for future industrial progress. Estimates are given of the total petroleum reserves in the world compared with recent consumption rates. It is noted that world reserves must be maintained in advance of consumption, that oil must not be wasted, and that new sources of oil must constantly be developed. Suggestions are made for the establishment of policies that would assure an equitable distribution of the oil resources of the world among the nations and for the establishment of distribution methods that would assure a fair share of oil for all concerned. *Standard Oil Company of New Jersey.*

New Meteorology Techniques for Air Transport in Alaska

Clipper Fleet. The work of Pan American Airways' meteorologists in establishing meteorologic service for the Alaska sector is recorded. Notes are included on the establishment of a regular weather-collection service between the United States and Alaska, the devising of a code which is now in demand by all agencies operating in Alaska, and

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2 Self-Tapping Machine Screws—Eliminate separate tapping operations in making fastenings to castings, heavy gauge sheet metal, and plastics.

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the synchronizing of all meteorologic facilities of the several agencies extending flight operations to and in Alaska. In addition to indicating the value of such a service, the review remarks some of the problems of operating it and cites the contributions of individual employees toward its success. *New Horizons*, July, 1944.

Negotiating Ryan Contracts

The Story of Contract Administration. The beginning of a series of articles on the Contract Administration Department of the Ryan Aeronautical Company discusses the negotiation of contracts. It notes the contributing activities of the Statistics and Priorities Group and tells something about the personnel of the department.

The second article outlines the functions of the Contract Readjustment and Airplane Service sections. It also deals with the specific duties of individual members of the department. *Ryan Flying Reporter*, June and July, 1944.

Air-and-Bus Service

Greyhound Looks Ahead to Integrated Air-Bus Service. An illustrated booklet explains the plans of a large bus-operating organization for the extension of its activities to the operation of helicopters in an integrated air-and-bus service. It outlines briefly the carrier's past accomplishments and the facilities that it is believed could be adapted to air operations. A discussion is included of the characteristics of the helicopter making it suitable for this kind of work, and statistics are given to show the extent of the market for the proposed service. *Greyhound Corporation.*

Lignin Plastic Board Bulletin

Bulletin 6 describes and illustrates Walesite, a laminated lignin plastic board, used in plate sets and for hole-punching units set up on template mountings. Physical properties of this material, which is reported to be especially adaptable for use with the maker's hole-punching equipment, are fully described in this bulletin. *Wales-Strippitt Corporation*, North Tonawanda, N.Y.

Catalogue of Thermal Control Equipment

Fenwal Thermoswitches is a 44-page illustrated catalogue containing descriptions of more than 20 of the manufacturer's products. It includes installation drawings and photographs for both temperature-control and pressure-control apparatus, and a brief history of the company. General details of the Thermoswitch are graphically explained with the aid of a 14-in. cutaway illustration. The device is based on principles of heat and cold control in which expansion or contraction of the shell causes contact action.

The switch has had wide application in industrial and commercial use and may be used throughout the entire range of temperature-control work from below zero to 1,200°F. Various types have been designed for the control of temperatures of solids, gases, and liquids. New adaptations have been added for aircraft and railway use.

A large section at the back of the catalogue is devoted to a description on "The Selection and Application of Thermoswitches." This section is illustrated with actual temperature charts and diagrams to show the basic principles involved in accurate temperature regulation. The article covers inspection and testing procedure. *Fenwal Incorporated*, Ashland, Mass.

Manufacture of Spinners

Spinner Noses. How the facilities of plants formerly manufacturing automobile headlamps were applied to the production of aircraft spinners is related. It was found that the facilities and experience used in the production of streamlined automobile headlamps could be applied to the production of similarly shaped spinner noses as coverings for aircraft propeller hubs. Guide Lamp Division and the Moraine Products Division of General Motors Corporation undertook this work, reversing the previous method of drawing out the nose of the cone first. Details are given about the series of operations developed and the machines used in this process. *GM Folks*, July, 1944.

Organization of Flying Clubs

Flying Clubs. A booklet of 28 pages contains suggestions for the organization, management, operating methods, and safety rules for clubs for private owners of airplanes. It is based on a study of flying clubs throughout the United States, through extensive records referring to aircraft insurance, and by the engineering services of insurance concerns. It includes advice about club operations, costs, equipment, rules, maintenance, limitation of membership, and a digest of the Civil Air Regulations. A form of constitution and by-laws for a flying club is offered, and suggestions are made for the establishment and enforcement of regulations to govern the activities of private fliers. *Aero Insurance Underwriters*, New York.

Belt-Drive Catalogue

Fractional Horsepower V-Belt Drives is a new 44-page handbook that gives information about this method of applying power for driving factory machines.

The booklet notes the trend toward larger sheaves in both fractional-horsepower and multiple V-belt drives, describes the construction of the manufacturer's fractional-horsepower V-belts and gives data on both sheaves and belts.

One of the most useful portions of the handbook is the chapter on proper selection of fractional-horsepower belt drives, with formulas, together with a page on how to get the most service from V-belt drives. Horsepower ratings and general engineering data concerning these drives are given, together with selection tables of stock drives using pressed-steel and cast-iron single-groove sheaves and adjustable cast-iron single-groove sheaves. Twenty-seven pages are devoted to these tables. *The B. F. Goodrich Company.*

Hydraulic Control Circuit Speeds Gears

Gears, Ancient and Modern. Beginning with a brief outline of the history of gearing from the Egyptian era to modern times, this article goes on to explain how gear-grinding was improved through the application of hydraulics to the indexing operation. It describes the features of the Vickers hydraulic control circuit, reviews the principles of the system's application to gear-grinding machines, and indicates the timesavings that are effected. *Sperryscope*, July, 1944.

Manual Defines Aircraft Quality Control Standards

A Standard Quality Manual, providing a uniform set of definitions covering the quality of aircraft parts and materials, has been prepared for all major West Coast air-frame companies and their outside production sources. Inspectors, technical writers, and illustrators from the seven companies compiled the 188-page manual because of the need for a uniform understanding of objectives in maintaining quality control in war production.

The manual does not prescribe inspection procedures, which may vary between manufacturers, but endeavors to reduce each subject to the clearest and most concise language on which a large number of experienced inspectors can agree. Its purpose is twofold: to enable all inspectors to work by a uniform set of rules, thus improving coordination between inspection and production departments; and to serve as a reference work in training inspectors.

In reducing the intricacies of inspecting aircraft parts, materials, and equipment to terms understandable by persons with limited technical training, the book makes extensive use of drawings, photographs, and cartoons. Each operation is illustrated and described, the proper method being shown in blue and the incorrect way in red.

Direct reference to specification numbers is purposely avoided, and no effort has been made to incorporate factory procedures. Since specific information concerning aircraft materials and processes is constantly being revised, inspectors must be familiar with current specifications. The manual was compiled purely as a reference work and is not used as an authority or to supersede existing governmental, commercial, or prime-contractor specifications. *Aircraft War Production Council, Inc.*

INDIVIDUAL SWITCH SHIELD *to house* **AN3017, AN3018 or AN3022 switches.**

UNIONAIR MODEL 11R4

Our production of electrical assemblies for important aircraft manufacturers often brings up a situation requiring an individual switch located outside the general switch panel and completely shielded for conduit wiring. This shield has been produced to answer this need with a minimum of space and weight.

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Electrical Assemblies—Hydraulic Fittings
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Booklet on Turnbuckles

Aircraft Turnbuckles is a small pamphlet containing illustrations, technical data, and specifications referring to turnbuckles for aircraft use. New and old methods of manufacturing these devices are shown, with figures giving the timesavings accomplished. Tables give specifications for various types of turnbuckles to meet Army and Navy requirements. *Reliable Electric Corporation*, Chicago.

Helicopter Book

Bendix Helicopter describes the design of a type of helicopter including specifications and a brief description of the features of this particular model. It contains also a brief statement about the manufacturing organization and lists its officers and directors. *Bendix Helicopter, Inc.*, New York.

Bulletin on Foundry Ovens

The improved line of Despatch Coremaster Drawer Type Ovens is described in a colored folder that shows a variety of uses for ovens in foundry practice.

The bulletin sketches advantages of this type of oven for the large and for the small foundry, gives details of the construction features, and lists 48 standard models available with gas, oil, or electric heating systems. *Despatch Oven Company*, Minneapolis.

Plywood Data Sheets

The Design of Flat Panels with Stressed Covers constitutes section 8 of the handbook *Technical Data on Plywood*. It is issued for insertion in the loose-leaf binder containing other similar sections.

This section gives information resulting from studies and tests on stressed-skin panels. It contains definitions and methods of calculation, as well as tables and mathematical formulas for computing the strength properties of this material. *Douglas Fir Plywood Association*, Tacoma, Wash.

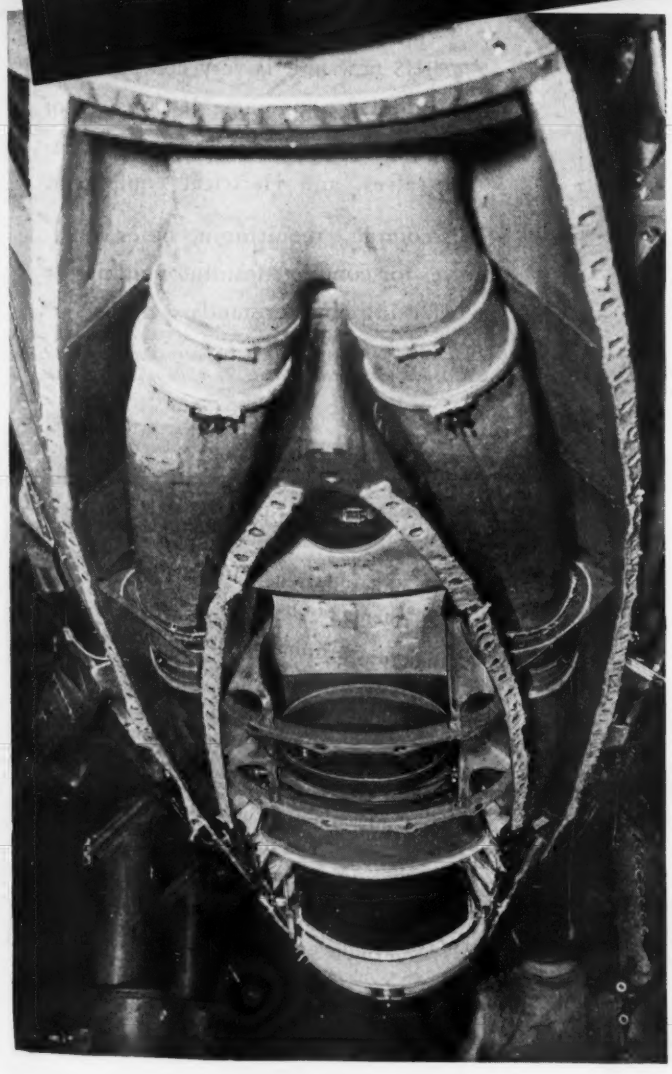
Catalogue Section on Rivnuts

A new catalogue section, No. 1250, describes the Rivnut blind fastener which is used as a nut-plate, rivet, or both. One page is devoted to a pictorial step-by-step presentation of a typical installation. Another page is given to a chart showing pertinent details on all types of Rivnuts. Methods of preparing the holes for the fastener and upsetting them and a discussion of types and the realm of service for each are included. *The B. F. Goodrich Company.*

The Horsepower of an Aircraft Engine

Millions of Horses. An elementary explanation of horsepower. The power of a 2,200-hp. aircraft engine is interpreted in terms of the ability of an equal force to perform other operations, such as driving a locomotive, a generating-plant installation, a tugboat, etc. *Trade Winds*, July, 1944.

This Is How a Thunderbolt Exhales



Here is part of a hard-hitting "Thunderbolt's" exhaust system—one of the hottest spots in a fighting plane.

Exhaust gases roar through this network of piping at temperatures of 1500°F. and higher—too hot for most metals to endure. This is why ARMCO Stainless Steels are used for the complete exhaust systems in many of Uncle Sam's warplanes.

ARMCO Stainless is doing its job well too. In firewalls and exhausts these rustless, durable metals defy red hot temperatures. In many other parts light though strong sheets of this hard, tough metal resist corrosion and the vibration of roaring engines.

If you are making vital parts for America's warplanes, consider ARMCO Stainless Steels. They are supplied in the conventional types, including the Columbium and Titanium stabilized grades. And remember them where resistance to heat and corrosion are needed in your peacetime products. For complete information about ARMCO Stainless just address The American Rolling Mill Company, 2931 Curtis St., Middletown, O.

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A New Altimeter Test Unit for Testing Altimeters and Rate-of-climb Indicators

THIS new unit is very compact, and simple to operate. It consists of chamber, integral vacuum pump, control valves, and electrical equipment.

It is complete requiring no other accessories for complete testing of altimeters when using a master standard altimeter.*

**A standard Meriam well type manometer can be furnished with scale graduated directly in altitude if required.*

THIS **Altimeter Test Unit** fills a long standing need in the field of testing.
ASK FOR BULLETIN 26

Unit with cover open

Among the many features of the Meriam Altimeter Test Unit are:

1. Chamber designed for testing four instruments at one time.
2. Internal instrument mounting plate removable from chamber for independent mounting of instruments.
3. Vibrator included which eliminates drag on indicating pointer of instruments.
4. Heavy duty vacuum pump which will evacuate chamber to 2 inches of mercury absolute or equivalent of 60,000 feet.
5. Metering valve for accurate control of vacuum exhaustion and rate of vent.

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Production Suggestions

The following suggestions for improved production methods are among those recently reported as having won prizes offered by the various companies:

The Consolidated Vultee Volunteer, July 14, 1944. (1) Idea for a nut-plate rivet set; (2) modification of the magnetic rivet gun.

Convair News, July 14, 1944. (1) Production-line system designed to increase output and cut costs in the manufacture of Kirksite dies; (2) shortened shanks on Q-rivet sets, to promote faster and better workmanship; (3) redesigning tool for cutting holes in fabric covers.

Douglas Long Beach Airview News, July 11, 1944. (1) New type of die for swaging balls on the rotary machine to permit use of the swaging machine instead of the riverter.

North American Skywriter, July 14, 1944. (1) Elimination of washers in Dzus spring installations; (2) curco tubing stretcher whereby, with the aid of a metal tube, the curco is inverted to facilitate the insertion of wires; the air pressure is then released and the curco adheres to the cable.

Douglas Tulsa Airview News, July 7, 1944. (1) Fuel-gauge testing jig to speed up the calibration before the gauge is installed instead of after installation, thereby saving an estimated 29 hours per plane.

North Ameri-Kansan, July 14, 1944. (1) Hi-shear rivet collar remover in the form of a fly cutter with a retractable center pilot, used with an air drill; this cutter cuts off the rivet collar to the same diameter as the shank of the rivet, making removal easy; (2) a locating template for the upper turret deflector; (3) a trailer for hauling wings; (4) improvement in the production of an air scoop.

Convair News, July 21, 1944. (1) Improved method of fabrication of part of the bomb bay bulkhead for the Liberator; (2) special squeeze set permitting the use of an ordinary riveter in assembling Liberator ribs.

North American Aviation, Inc., Take-Off, July 21, 1944. Hinged inserts for supporting the web and flanges of P-51 engine-mount beams as they are bent. These blocks prevent wrinkles from occurring in the web and cause a more uniform bend to be produced.

Simmonds Aeronews, July 22, 1944. Use of operational rejects in setup operations rather than sending them to salvage.

McDonnell Bulletin, July 21, 1944. Joint award for a method of expediting a trimming operation on cowl panels through lifting the trim templates vertically from the fixtures by means of a counterbalance.

Noorduyn Tale-Spin, July 1944. (1) Three separate containers in which to keep resharpened drills, each properly labeled to identify the type and size of drill, instead of a single container in which various types were mixed. A special checking rack also was made for the finished drills. (2) A flaring and deburring unit used for Norseman Teleflex conduits, permitting handling of conduits while they are being flared, eliminating the possibility of cracking them. (3) A box-type container through which stringers are passed. (4) Checking gauge installed as a permanent part of the jig, to maintain correct positioning. (5) Special clamp devised to facilitate installation and assembly of engine governors while being tested. (6) Addition of a lug to each corner of the engine-mount fixture while soap-testing, improving safety and eliminating the need to use a hammer during assembling. (7) Special trimming and drilling jig for Norseman auxiliary panel, eliminating unnecessary handling and trimming.

North American Aviation, Inc., Take-Off, July 14, 1944. An improved method of stamping stringer clearance cutouts in the belt frames on the B-24. Previously made separately, the more than one thousand of these cutouts per plane are now blanked out in a single operation for each part, by using punch-press dies which can be located by templates under the press.

Douglas Oklahoma City Airview News, July 1, 1944. (1) Use of cut-awl for making the masks for various markings on the C-47. These had previously been cut singly by hand with a stencil knife but by using a machine 200 sets of numbers can be cut in 20 operations. (2) A long-range fuel-tank beam assembly, made in one piece instead of the former processes by which it was manufactured in four pieces. Previously the assembly had been made from 2-in. fir and weighed about 32 lbs. It is now made in one piece of $^3/_4$-in. fir plywood, eliminating a center cut, splice, block, and ten nuts and bolts, and weighs half as much as the old style. In addition to eliminating the scrap from the former method, a use has been found for the scrap resulting from the new method.

North Ameri-Kansan, July 7, 1944. Design of a work table and tools and a method for preparing the aluminum deicer strips used for attaching rubber deicer boots to the leading edges of the wings and empennage. These are packed in a field kit for each airplane, to be used as needed. Because of their shape and construction, 29 different sizes are used, all requiring a $^5/_8$-in. bevel from 0.032 to 0.010 in. The new method and tools make this precision operation more efficient and speedier.

The Bellringer, July, 1944. (1) Miter box for angle sawing of tubing with micromatic scale for degrees. (2) Reversible hinge for template used for marking wing gas-tank covers.

Douglas Airview, July, 1944. (1) Milling fixture to hold rudder pedal arms on spear plugs in the cored holes of rough castings. (2) Spring-winding tool and spring-loop bender accessory that makes more cheaply any size or any type of tension, compression, or taper spring faster. (3) An air-hammer punch and squeeze device that cuts and punches bonding braid and installs braid in Sta-Kon fitting. (4) Flange-straightening pliers for BTD hat sections which eliminates hammering, does not mar, and leaves even surfaces. (5) Fixture for combining all plug, snap, and thread gauges into one unit adjustable to many different sizes, lengths of instrument-hose fittings, and connections. (6) Use of pneumatic squeezer to squeeze grommets into place to hold parts together for spotwelding. (7) Installation of block at forward part of fulcrum on aircraft to combine and simplify the checking of parking brake and brake lines. (8) More economical and quicker method of operating and checking oxygen system, applicable to any plane having recharger hose and dual-type check valve. (9) Use of Hycar pliable rubber sheet instead of grease coating on stretch press for saving of time, labor, materials, and money. (10) Improved shrinking die, which utilizes roller-activated jaws working against heavy spring tension, creates larger bearing surface and greater holding and squeezing power without injury to part. (11) Device for holding intercostals to formed angles while Erocing. (12) Multi-use spanner wrench which may be blanked or torch-cut in one piece. (13) Hinge adaptor for squeeze gun to set rivets from inside of panel, used primarily for riveting window rings to fuselage.

Flagship News, July-August, 1944. (1) A spring-loaded position bolt on the cylinder-lapping machine which eliminates cause of concentrated lapping within the cylinder and consequent damage to the machine. (2) Jig for use in the installation of cabin seat units. (3) A modified trailing-wire antenna weight that offers a safety feature and effects a saving in material and labor. (4) A puller for removing taper pins from fuel tanks and engine selector-valve universal-joint linkages.

The Jahco News, July, 1944. (1) New screen filters for Brown & Sharpe grinders result in a saving on oil and time. (2) Installing a special fixture with an air chuck on a drill press releases turret lathes and increases production. (3) Using a hand breast drill and a special pivot screw driver, fastened to the table, to extract pivots out of vertical rings eliminates a hand operation, reduces fatigue, and increases production. (4) An attachment to a speed bench lathe for lapping bearing races enables the races to be released and the motor to be stopped by the shifting of a lever. (5) A wedge-type commutator remover can also be used in removing Monel rings and commutators on all armatures.

Douglas Oklahoma City Airview News, August 5, 1944. Changes in the floor assembly of the lower nose section of the fuselage comprising two suggestions, the first of which was a stiffener to be cut to fit before the stiffener leaves the hydraulic press. The second award was for a suggestion to relocate holes in the bracket support where the drum assemblies fit, both suggestions eliminating filing and reaming operations.

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Uniform Welds Assured By New Oakite Technique

To get the uniform welds you desire, use this new successful Oakite technique for preparing aluminum surfaces prior to spot welding: FIRST, in your pre-cleaning use Oakite Composition No. 61 for thoroughly removing tenacious identification inks and paints without hand scrubbing. THEN, for the de-oxidizing process use Oakite Compound No. 85 at ROOM TEMPERATURE which SAFELY, speedily removes oxide film . . . leaves surfaces in excellent condition for welding. Data FREE!

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ATLANTA CHICAGO LOS ANGELES

North Ameri-Kansan, August 4, 1944. (1) A brake for table saws, to avoid the delay sometimes amounting to 4 or 5 min. for the blade to stop revolving in order to change the setup for different operations. The hand brake devised stops the saw in less than 30 sec.; (2) self-feeding parts dispenser; (3) band saw contour jig.

The B. F. Goodrich Circle-News, July 21, 1944. An idea for saving fuel-cell fabric in the production of bullet-sealing gasoline tanks for the B-29 and other planes.

North American Skywriter, July 28, 1944. (1) Improving the design of circular saws, thereby increasing cutting efficiency; (2) a way to rework the pierce and blank die to eliminate one operation for the hydraulic press; (3) a multiple tool holder for forming tools for the turret lathe; (4) an aligning device for use in installing cockpit seats in fighter planes; (5) introducing the use of Cerrobend for molded jigs to facilitate the stamping of airplane castings and parts.

The Chance Vought News, July 27, 1944. (1) Revised method for handling bar stock by inspecting it for imperfections before processing, thereby eliminating waste and saving time and money. (2) Design of a large counterbore with a small taper to fit the machine used in the first drilling operation on the main beam web, thereby bringing the drill closer and more firmly to the work. (3) Arrangements for keeping the landing-gear retracting strut in a controlled path of operations during the hydraulic-pressure test, preventing damage caused by a loose strut.

North American Aviation, Inc., Take-Off, August 4,. 1944. (1) Improved manufacturing procedure on the B-24 fire-wall panel to save material and labor. The 20 parts of each fire wall which must be formed and punched with $^{3}/_{8}$-in. holes are sheared to size and the holes are all punched at one time instead of singly, thus saving material and time. (2) A simple method of clearing drill-motor armatures before they are rewound.

The Faircrafters, July 28, 1944. (1) Construction of a specially designed cabinet to be used in the final assembly department, where stencil and decal operations are performed, to save 21 man-hours per airplane. (2) A jig for drilling the end holes in all major control bellcranks, to be used after the bearings are riveted in, thereby eliminating rejections caused by variations in length and degree of angle of arms. (3) An inexpensive furnace for melting aluminum used in casting Duramold dies and also for melting small quantities of aluminum required for machine repairs. (4) Suggestions for the use of aluminum castings for Duramold forms. (5) A measuring rod for determining the length of control rods.

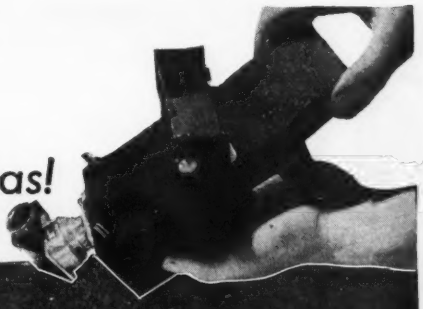
North Ameri-Kansan, July 28, 1944. (1) Means of eliminating radio noise in an SCR 522 radio; (2) an adjustable welding clamp; (3) use of talcum powder to thicken bonding fluid; (4) a wire-threader device.

The Northrop News, July 19, 1944. (1) Propeller-governor synchronization tools, to save approximately 6 hours of adjustment time per plane, also saving gasoline required for engine runs; (2) device for holding skins while being burred; (3) contour dies used in pneumatic press; (4) jig for assembling seals; (5) valve-holding fixture and other special tools.

North American Aviation, Inc., Take-Off, July 28, 1944. (1) Idea for attaching stainless-steel washers to the contactors on all spot-welders, to change the magnetic characteristics of contactor switches, thereby improving the operation and reducing repair time. (2) A method for punching a large number of holes in engine-cowling parts for the Mustang.

GM Folks, July, 1944. (1) Recutting and redesigning old dies for piece-marking operations, instead of discarding them. (2) Suggestion for saving 70 to 100 autosyn housings per day. (3) Changing a burring job, increasing production 20 per cent. (4) A plate for tapping threads in a housing. (5) Eliminating the tail stock by placing a stop in the lathe collet. (6) A fixture to facilitate the alignment of a locomotive dynamic-grid motor and blower shaft, simplifying the operation and releasing a man for other duties.

These great ACTION sequences made with Fairchild gun cameras!

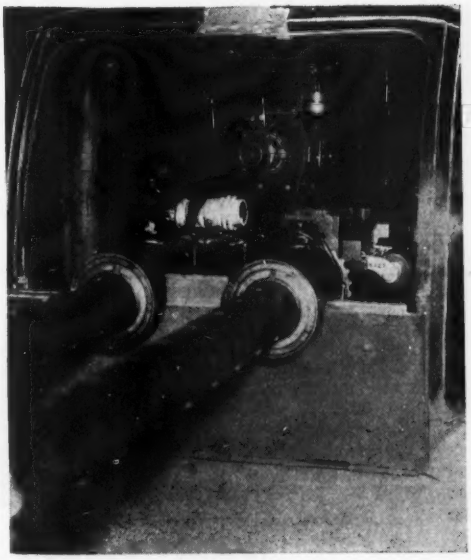


In newsreels recently, you've probably seen plenty of movie sequences showing Messerschmitts, or Zeros, being literally 'blasted' from the skies. These pictures were taken originally *not* to furnish you with entertainment; rather, to furnish our armed forces with *indisputable proof* of enemy planes destroyed!

These pictures are taken with a very unusual type of 16 mm movie camera . . . known as the Fairchild GSAP. Mounted close to the plane's guns, and to follow the bullets' course, these cameras automatically 'grind' while guns are firing, and stop only after the last bullet has reached the target or the target area.

You might well ask . . . "how can such a light, compact 16 mm camera operate so dependably in face of the incessant pounding and vibration from engines and guns?" The answer, of course, lies in its unique design and in its precision manufacture. Designed in cooperation with U. S. Army and Navy experts, it is built to the same precise standards which have kept Fairchild constantly in the aerial camera lead.

It's the kind of camera every movie owner some day hopes to own.



The Fairchild Gun Sight Aiming Point Camera is mounted close to the guns, to *record* all action.

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You don't have to translate the language of a Mustang's 50 calibre guns or the 75 millimeter cannon talk of a Mitchell bomber. The Japs already understand. So do the Nazis. So let's keep talking. You bet you can help! Think of it this way. The Bonds you buy help build these fast-talking planes. The waste fat you collect helps arm them. Waste paper helps ship them, and gasoline flies them. Wouldn't you like to say a few words of this kind of "peace talk," too?

North American P-51 Mustang Fighter
BULLET-PROOF ARMOR
FULL-VISION COCKPIT ENCLOSURE
1520 H. P. SUPERCHARGED ENGINE
REVOLUTIONARY SUPER-SPEED WING
SELF-SEALING GAS TANKS
SIX 50-CAL. MACHINE GUNS, THREE IN EACH WING
1000 LB. BOMB UNDER EACH WING
THE MUSTANG IS A FIGHTER FROM THE GROUND UP! Speed: over 425 m.p.h. Ceiling: 40,000 feet Range: 2000 miles

North American Aviation *Sets the Pace*

PLANES THAT MAKE HEADLINES... *the B-25 Mitchell bomber, AT-6 Texan combat trainer, P-51 Mustang fighter (A-36 fighter bomber), and the B-24 Liberator bomber North American Aviation, Inc. Member Aircraft War Production Council, Inc.*

From the Industry

Detachable Hose Fitting

Aeroquip detachable, re-usable hose fittings are now available for use with low-pressure hose (Specification AN-ZZ-626a). Hose lines can be made up or replaced by untrained personnel without special tools. All parts of the fitting assembly are removable and re-usable individually, eliminating the need for stocking complete subassemblies. This feature is of importance because the nut is likely to be damaged during installation and service more frequently than other parts of the fitting assembly.

The design is so simple that the fitting may be assembled and disassembled with a common wrench by holding the hose with one hand. Making the assembly involves simply screwing the fitting together without regard for torque. The assembly requires no tightening, no adjusting, no continued future servicing. Fittings may be used many times over. Aeroquip Corporation, Jackson, Mich.

Welding-Control Panel

The Wilson Type 30 special tack welding circuit-control panel is a new and improved circuit-control panel for tack welding with a constant-potential power supply.

The resistors of Nichrome wire are mounted on insulators and are designed well within the permitted temperature rise. The housing has sheet-metal sides with expanded metal top and bottom to provide for full circulation of air. The mounting brackets are so arranged that panels can be mounted side by side or one on top of another without restricting circulation. The brackets also provide a convenient means for carrying the panels when they are not used at fixed locations.

Current values are controlled by specially designed contacts and are adjusted by turning fiber handles tight against a copper bus bar to connect the various resistors into the circuit, output current being the sum of the resistors so connected. Resistors are disconnected by turning the handles in the opposite direction and locking them in position.

Panels are available in 150-amp. and 230-amp. sizes, having taps for 10, 20, 40, and 80 amp. The 230-amp. panel has an additional tap for 80 amp. Current adjustment on both units is possible in 10-amp. steps.

The panel is designed so that calibration figures marked on the panels are correct when connected to a 65-volt generator with 25-volts arc and 5-volts drop in the welding head. The drop in the panel is 35 volts at rated current values. Air Reduction Company, New York.

Releases are printed as received from companies and other aeronautical organizations and the responsibility for the accuracy of all statements is therefore not assumed by the Aeronautical Engineering Review.

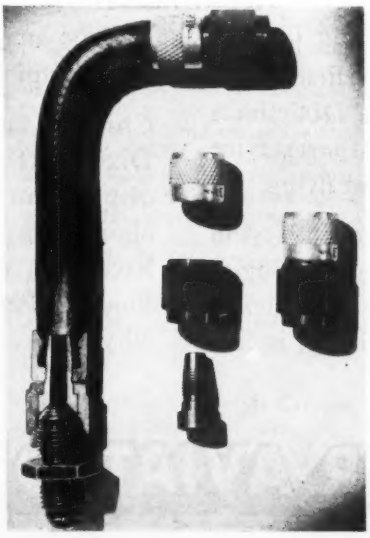
Visual Diameter Control for Grinding Operations

An improved Pratt grinding gauge, which continuously measures the diameter of external cylindrical jobs while work is in progress, and automatically indicates the point at which the correct diameter is reached.

The improved gauge is reported to also provide a continuous visible check on out-of-roundness and the amount of error. It is stated that perfect roundness and accuracy of diameter within 0.0001 in. can be maintained even by semiskilled operators.

The gauge is adapted to both straight and tapered work. A special feature is that work is also automatically measured while stock is being removed, thereby saving the time of further calipering. At no stage of the operation need the machine be stopped for hand calipering.

The standard model measures diameters from $^5/_{16}$ in. to 27 in. Special gauges, such as those for side-wheel grinding, are made to meet individual requirements. American Diamond Tool & Gauge Company, Detroit.



The Aeroquip detachable hose fitting.

New Aircraft Heaters

The series SRH aircraft heaters are reported to embody a new combustion process known as vapor entraining. This process uses a capillary vaporizing block in conjunction with preheated combustion air. To avoid lead-oxide formations and prolong life of burner parts, the flame is completely suspended. An unusually low-pressure drop permits efficient operation at low ram pressures. The flame is said to be so stable that its characteristics are the same regardless of the plane's altitude or speed, and barometric compensation permits operation up to 40,000 ft.

Another feature of the SRH series is the use of multiple heat-exchanger compartments giving the flame and hot gases a travel of four times the length of the exchanger. Capacities available are 100,000 and 50,000 B.t.u. per hr. Complete with all controls and accessories, the former weighs $24^1/_2$ lbs., the latter 16 lbs. 6 oz. Dimensions are 28 by 9 in. and 27 by 7 in., respectively. Blowers can be supplied for ground operation. Anchor Post Fence Company, Fluid Heat Division, Baltimore.

Direct-Reading Magnetic Compass

Type 2221 direct-reading magnetic direction indicator compass is particularly adapted to passenger and cargo planes, as well as to private aircraft. The azimuth pointer rotates in front of a fixed dial, and the settable course reference lines are intended to relieve pilot strain over long flights. This instrument uses a standard $3^1/_4$-in. luminous dial, graduated every 2°, and combines a short time of swing or period with a low value of overswing and a high lateral dynamic stability. These characteristics are reported to result in quick response and high stability in rough air.

The entire mechanism is permanently immersed in compass fluid to eliminate friction as much as possible. Wide-range temperature and magnetic com-

from WAR PAINT *to* CIVVIES

Released C&S Plane in background. Group (L. to R) R. L. "Doc" Anderson, Superintendent of Engineering C&S; Don Sprague Douglas Customer Service Manager; "Hap" Anderson, Chief Pilot, C&S.; J. M. Rogers, Vice Pres., Douglas Contract Administration.

HERE is a war veteran back in "civvies". It is the first of the Chicago and Southern Dixieliners released from Army transport service for return to commercial flying.

A fast overhaul and reconversion ... now, this 21-passenger Douglas airliner, soundproofed and lightened with a new fiberglass lining, is furnishing increased transportation on Mississippi Valley air routes.

Chicago and Southern's fleet of Dixieliners (complete since release of planes in Army service), use Sinclair Pennsylvania Motor Oil. They have been efficiently lubricated by Sinclair Pennsylvania for the past 10 years.

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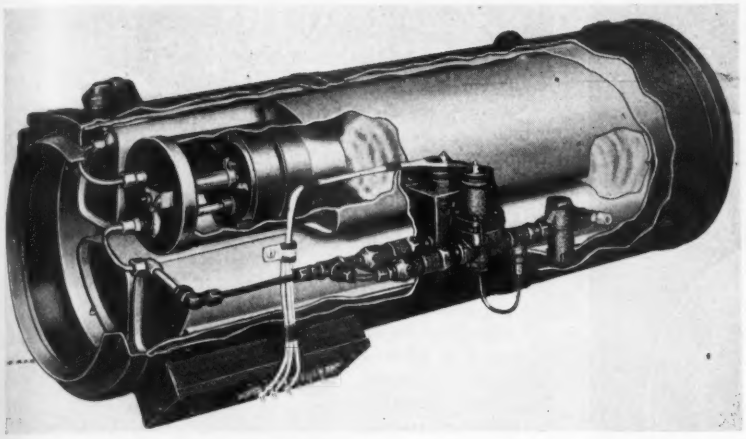


The Anchor Post Fence Company's SRH aircraft heater. This cutaway view shows the flame and intercompartment pass. The ventilating air moves from right to left.

pensation are provided within the housing, and each instrument is equipped with a nonmagnetic adjusting screw driver. Total weight of the instrument is 1.1 lbs. Autoflight Corporation, Burbank, Calif.

Oversize Rotating-Beam Fatigue-Testing Machine

The model SF-10 R rotating-beam fatigue-testing machine is designed to help "see around corners" in testing materials. Its design is based on published reports of studies which indicate that specimens of 1 in. minimum diameter eliminate "size effect" in fatigue.

It has a testing capacity from 0 to 10,000 in.-lbs., adjustable by units of 5 in.-lbs. (bending moment) by position of the weight on the beam. Specimen length is adjustable from $3^1/_2$ in. to $9^1/_2$ in. Baldwin Southwark Div., The Baldwin Locomotive Works, Philadelphia.

Compression-Yield Strength Jig

The Montgomery-Templin jig provides a convenient apparatus for making tests to determine compression-yield strength of aircraft sheet metal. With the new method, it is possible to test a single thickness of sheet in compression, supporting the sheet in the jig by a multiplicity of small rollers. The extensometers are attached to the edges of the sheet. The testing of the material in single-sheet form instead of packs simplifies the technique. The new jig is expected to offer possibilities in plastics as well as in metals. Baldwin Southwark Div., The Baltimore Locomotive Works, Philadelphia.

Spitfire Mark XI

Another version of the Vickers-Armstrongs (Supermarine) Spitfire, designated as the Spitfire PR Mark XI, is an all-metal, single-seat, low-wing monoplane, powered by a Rolls-Royce Merlin 61, 63, or 63A engine of over 1,650 hp.

It is used for photographic reconnaissance duties. It has a Rotol four-blade, constant-speed propeller. Later Mark XI Spitfires have a retractable tail-wheel unit, which is hydraulically operated. There are two main fuel tanks in the fuselage and long-range tanks are fitted in the leading edges of the main planes. The cameras are fitted in the fuselage. Dimensions are: span, 36 ft. 10 in.; length, 31 ft. $^1/_2$ in.; height (with tail up and one blade in the vertical position), 11 ft. 8 in. British Air Commission.

Adjustable Hole Cutter

An all-purpose adjustable hole-cutting tool is designed to cut smooth holes in wood, steel, brass, hard rubber, aluminum, fiber, plastics, and other materials. Two sizes are available, each equipped with an easily resharpened high-speed steel blade. One model cuts holes to any diameter from $^5/_8$ in. to $1^1/_4$ in. through $^1/_8$ in.-thickness. The other model covers all expansions from 1 to $2^1/_2$ in. through thicknesses up to $^3/_8$ in. The tools operate in light drill presses, portable drills, or breast drills, and are also available with square shanks for use in hand braces.

The hole cutter consists of a drill that starts the hole and also serves as a pilot for the tool, a hardened body with a milled slot into which is set a specially ground high-speed steel tool bit, and a hardened and ground shank. Adjustment is obtained by loosening the hexagon bolt that holds a locking clip, and sliding the blade to the correct distance from the pilot. Thickness capacity of the tool varies with the type of material being worked. Metals up to $^3/_8$-in. thickness are cut quickly and smoothly. Wood, plastics, and compressed materials may be cut to greater thicknesses, the thickness capacity in most instances being unlimited. Bruno Tools, Beverly Hills, Calif.

Climb Milling with Single Carbide Blade Improves Finish

By changing from conventional milling with a multiblade, high-speed steel shell end mill to "climb cutting" with a carbide fly-cutter, production on milling the lug shoulder of a forged Nichrome steel rocker to be used in aircraft engines was increased from 30 to 110 pieces per hr. and the finish on the work pieces was appreciably improved.

In making the switch to carbides, an old multiblade, high-speed steel shell end mill $2^1/_4$ in. in diameter, which had previously been used at low cutting speed on this job, was converted into a fly-cutter by tipping it with a single blade of Carboloy grade No. 78-B. The tool had a 10° right-hand helix angle. The speed was increased to 550 surface ft. per min.; a feed of 7 in. per min. was used; and a maximum depth of cut of $^1/_4$ in. was taken. The cutter was fed across the work, which was held in a fixture. When the direction of rotation of the cutter was reversed to use "climb milling," the finish obtained was materially improved.

In addition to raising production more than 300 per cent, climb cutting with the carbide fly-cutter also gave an average of 1,500 pieces between tool grinds. Carboloy Company, Inc., Detroit.

Air-Line Shop Performs Modification Work on B-29

Practically all of the facilities of the Continental Air Lines, Inc., Denver modification center are now engaged in modifying the new Boeing B-29 Superfortress. The Continental plant had been engaged in the modification of B-17 Flying Fortresses. More than 2,000 of these bombers have been processed since the air line began modification work on February 16, 1942. The change-over to the B-29 not only has been accomplished without shutdown, but the company completed its initial quota of the new bombers in late February, 1944, well within the time limit set.

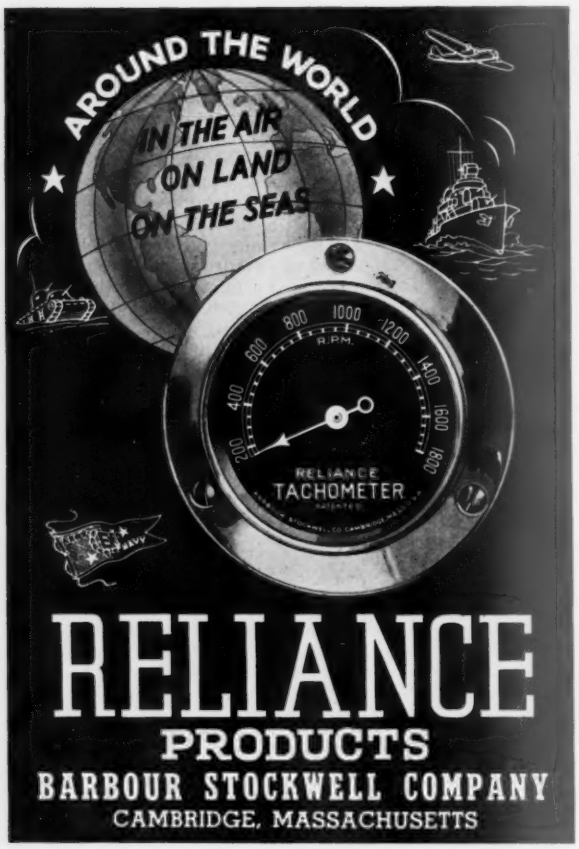
Modifications have been made to both combat and domestic aircraft, the latter being used in crew training by the Army Air Forces. The first of the B-29 planes modified by Continental for combat saw action in the recent raids on the Japanese mainland. Continental Air Lines, Inc.

Combination Grinder and Drill Press

The Dalzen "2-in-1" is a single machine designed to perform both center-lapping and drill-press operations. One simple adjustment, requiring only a few seconds, is all that is necessary to change over the "2-in-1" from center grinder to drill press or from drill press to center grinder. The operator has only to lift a pin and swing the center-grinder dresser in or out of position.

The machine is portable, weighing only 165 lbs. Its height is 67 in. and its floor stand measures 15 in. by 21 in. The 10 in. by 10 in. work table is slotted for T-bolts. Standard length between centers is 39 in. but other lengths are available on request.

The capacity of the drill press, which will drill to the center of a 13-in. circle, is $^1/_2$ in. The dresser is adjustable from 20° to 100°. The spindle rotates on two precision ball bearings, with a double bearing at the lower end to take thrust. The machine is shipped complete with



New MODEL 100V
ALL AMERICAN VIBRATION
FATIGUE TESTING MACHINE

THE new Model 100V subjects parts or assemblies up to 100 lbs. in weight to exhaustive vibration fatigue tests. Drilled and tapped work table has 4-point support and area of 15" x 18". Vibration mechanism runs in oil—no cooling devices required. Total displacement: 0" to .125" (adjustable). Frequency of 10 to 60 cycles per second (600 to 3600 vibrations per minute) is adjustable, and is recorded on electric tachometer. Capacity 23 g. Strength combined with precision for years of constant service. Send for Catalog "F" showing our complete line of automatic and manually controlled units.

Model 100V in research laboratory of Carl Hussman Engineers, Inc., Chicago, makers of vibration control and stabilization devices.

ALL AMERICAN
Tool & Manufacturing Co.
1014 Fullerton Ave., Chicago (14)

110-volt motor, V-belt drive, diamond, and $1^1/_2$-in. lapping stone. Dalzen Tool & Manufacturing Company, Detroit.

Tap Reconditioner

The Model DTR-3 tap reconditioner has been transformed into a "4-in-1" machine by the addition of facilities for grinding the full length of the tap flutes. These supplement the machine's original functions of chamfering, spiral pointing, and spiral-point polishing. Taps with 2, 3, 4, 5, or 6 flutes may be ground on one head. The entire flute-grinding and spiral-pointing unit is now of the sliding-table type.

Another feature of the improved machine is a new chamfering head that employs "quick-change" type collet chucks for standard tap-shank sizes, thereby making possible still greater speed in the reconditioning of taps. These collet chucks are interchangeable between the chamfering unit of the reconditioner and the unit for flute grinding and spiral pointing, and are attached by means of a simple draw bar, thus eliminating the use of lock nuts on both heads.

Capacities of both the tap-chamfering unit and the unit for flute grinding and spiral pointing have been increased. They will now accommodate collets from the smallest machine-screw size up to $1^1/_4$-in. standard tap-shank size, including long-shank taps.

The spindle head of the improved reconditioner now accommodates interchangeably a wide range of motor types for the various service voltages, phases, and frequencies required in the industry. A separate motor-driven unit with cone-shaped wheel mounted in the machine base for spiral-point polishing is furnished as a part of the standard equipment. Included among the standard accessories are a tap locator and three index discs for flute grinding and spiral pointing, which accommodate from 2 to 6 flutes.

Internally wired and terminating in a line switch at the base, the $^1/_2$-hp. spindle motor is controlled by a manual switch that is located in the base of the machine. Standard motors are 220 or 440 volt, three-phase, or 110 volt, single-phase, for either 25- or 60-cycle service. Detroit Tap & Tool Company, Detroit.

Low-Pressure Oxygen Check Valves

Offered by the manufacturer as conforming to the requirements set forth in specification AN-V-15, a new series of low-pressure oxygen check valves offers numerous improvements.

One feature of these new valves is the poppet. It is intended to eliminate excessive squeezing of the sealing element and remove the possibility of the gasket tearing loose or cutting through and being lost in the line.

The internal construction incorporates the "O"-ring sealing principle. The valve operates as a sleeve valve, the clearance of which is sealed by an "O"-ring type gasket when the valve is closed. The sealing element is made from special freeze-resistant Neoprene of low Shore hardness to insure proper functioning between −65° and +160°F. The Deutsch Company (formerly American Screw Products), Los Angeles.

Reconversion of Transports for Commercial Use

Reconversion of DC-3 transports, released from war service by the Army to supplement air-line fleets in handling an unprecedented volume of domestic traffic, is now under way. Among the first craft restored to prewar specifications and travel elegance was a Delta Air Lines transport and a former liner contributed to the war effort by Chicago and Southern Air Lines. Other reconversions are to follow in short order anticipating the day when it may be possible for the military authorities to relax travel priorities in this country. According to Washington announcements, an estimated 100 of these Douglas transports will be returned to domestic operators by fall.

It is expected that most of these DC-3's will be reconverted by the Douglas Aircraft Company. However, some air lines with sufficient shop facilities and personnel will do their own work, with parts and material supplied by the manufacturer. At one of the Douglas plants a reconversion assembly line has

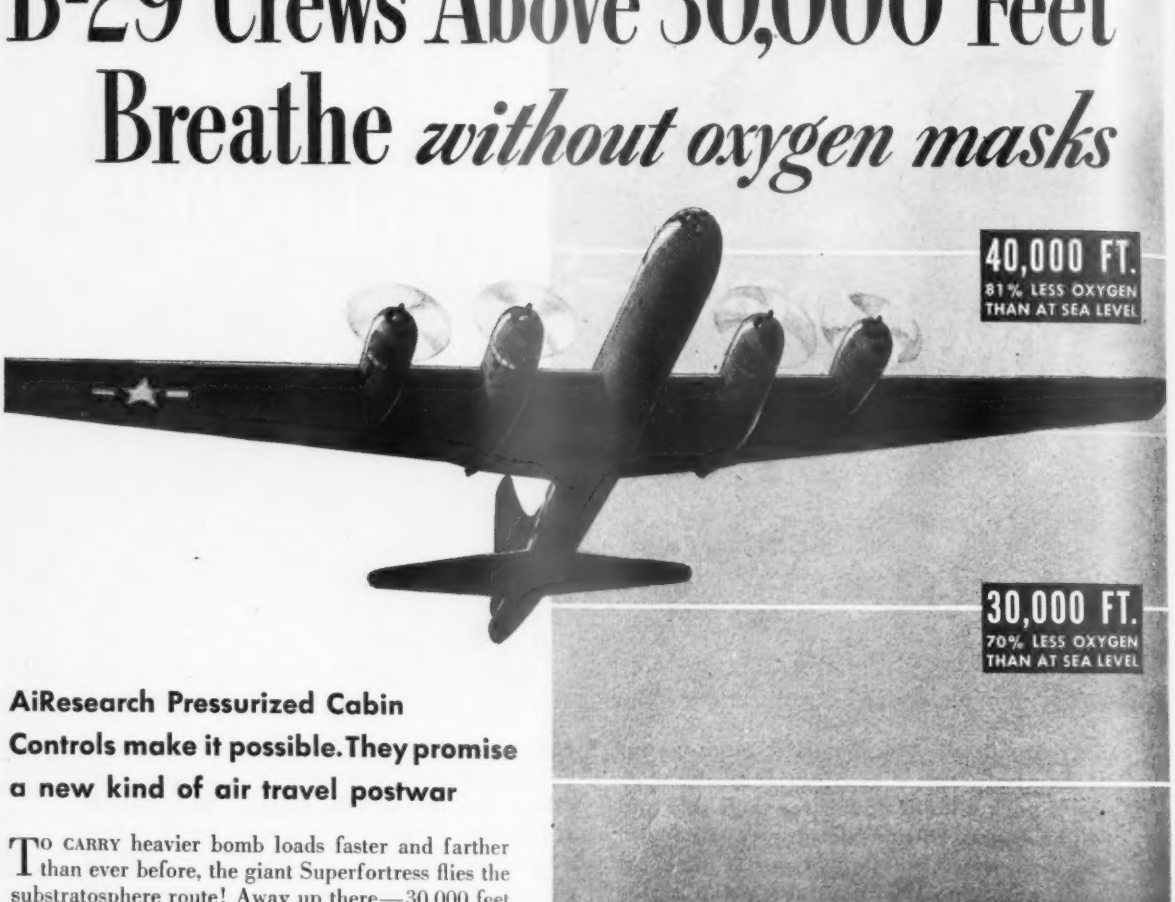
The dependable Delco electric motors that drive varied accessories in fighter and bomber planes pack a lot of power for their size and weight. Highly efficient designs, coupled with very accurate machining of parts, have cut down motor mass without sacrificing motor performance.

To the men who fly military planes, this reduced weight is translated into terms of increased armor, armament or range. Delco motors for fuel pumps, machine gun mounts, air pumps, windshield wipers, defroster fans and instruments are making their contribution to the effectiveness of American aircraft. Delco Products Division, General Motors Corporation, Dayton, Ohio.

DELCO MOTORS

DELCO PRODUCTS *DIVISION OF* GENERAL MOTORS

B-29 Crews Above 30,000 Feet Breathe *without oxygen masks*


40,000 FT.
81% LESS OXYGEN THAN AT SEA LEVEL
30,000 FT.
70% LESS OXYGEN THAN AT SEA LEVEL
20,000 FT.
54% LESS OXYGEN THAN AT SEA LEVEL
10,000 FT.
31% LESS OXYGEN THAN AT SEA LEVEL

AiResearch Pressurized Cabin Controls make it possible. They promise a new kind of air travel postwar

TO CARRY heavier bomb loads faster and farther than ever before, the giant Superfortress flies the substratosphere route! Away up there—30,000 feet or more—where air is much too thin to sustain life without the aid of oxygen masks.

It *was* too thin. *It isn't any more* inside the Boeing B-29 Superfortress. In its pressurized cabin, AiResearch controls constantly keep the air pressure at a safe "low altitude." And at the same time these controls maintain a comfortable flow of fresh air through the cabin.

Here men can live and breathe as at home, without oxygen masks or heavy, cumbersome clothing...without nausea or dizziness however high they fly.

AiResearch engineers worked long and closely with Boeing and the Army Air Forces to perfect the pressurized cabin. You'll hear more about this miracle of air control. A military achievement vital now, it will help make possible faster, smoother planes to speed postwar air travelers through the upper air in undreamed-of comfort. AiResearch Manufacturing Company, Los Angeles and Phoenix.

ARMY E NAVY

AiResearch
DIVISION OF
THE GARRETT CORPORATION

Superfortresses carry AiResearch Cabin Pressure Regulating Systems • Engine Oil Cooling Systems Engine Air Intercooling Systems • Supercharger Aftercooling Systems • Automatic Exit Flap Control Systems • Temperature Control Systems

been set up to handle the program, which is part of the Government's plan to cushion the employment slack occasioned by curtailment of bomber contracts.

Reconversion to air-line specifications will include shifting or installing of bulkheads, installation of lightweight honeycomb floors, rework of heating and ventilating equipment, replacing of cushioned seats, handrails, hatracks, soundproofings, interior linings, and on some models changes in the main entrance door and windows. In addition, where the work is done by Douglas, the reconversion will include latest engineering changes to make the plane airworthy in compliance with the C.A.A. approval and air-line specifications as passenger carriers.

In cases where former air liners have been lost or have seen such military service as to make their reconversion impractical, they will be replaced by newer C-47's to be adapted for civilian use. It is estimated that it will take from 4 to 6 weeks to reconvert each returning DC-3. With the arrival of additional planes from Army service, and the installation of production equipment to handle these reconversions, the time per unit will be materially reduced. Douglas Aircraft Company, Inc.

Small Capacitor Motor

Type J-70, $^1/_{50}$-hp. capacitor motor is offered for powering small control devices of all types and for driving blowers in high ambient temperatures. Rated at $^1/_{50}$ hp. for use on alternating current of 160 cycles, 115 volts, single-phase, the motor operates at 3,400 r.p.m. Its diameter is $3^5/_{16}$ in., overall length is $3^1/_8$ in., shaft diameter is $^5/_{16}$ in., and the weight is 3 lbs.

The motor can also be supplied with a rating of $^1/_{25}$ hp. and can be wound for two- or three-phase power, or furnished for 400-cycle applications at higher speeds and ratings. Eastern Air Devices, Inc., Brooklyn.

New Lightweight Magneto

The new Edison SF9LD-1 aircraft magneto is reported to be more than 6 lbs. lighter than others of the same capacity. It is installed as standard equipment on the Wildcat fighter as built by Eastern Aircraft Division of General Motors, the Douglas Dauntless, the Curtiss Scout, and the Grumman and Columbia amphibians. Experimentation and research have made it possible to limit the weight of this instrument to approximately 9 lbs. without sacrificing any of the electrical output, mechanical strength, or all-round efficiency expected of magnetos designed for this class of service. This was accomplished without the use of any light metals other than aluminum.

The Edison aircraft magneto is of the rotating-magnet type. The roto carries two laminated segments of soft iron placed over semicircular cast Alnico magnets which are permanently polarized. The rotation of the two-pole rotor serves to direct the flux through the wide sections of the laminated pole pieces extending into the rotor tunnel,

Rear view of the Edison-Spitdorf SF9LDI-magneto.

while the opposite ends form the extensions for the stationary coil core which is mounted at right angles to the axis rotor. The makers state that this construction gives excellent sparking characteristics at low cranking speeds, together with superior performance at high speeds. Elongated slots are provided in the magneto flange for adjustment of the timing. The Edison magneto is designed to be capable of producing a potential of double the rate of 2,000 to 8,000 volts needed for ordinary operation whenever necessary, with no strain or injury to the high-tension parts. No secondary condenser is used.

In order to provide compactness and accessibility the rotor is carried vertically on ball bearings. The lower end of the rotor shaft is serrated, over which is fitted the spiral-bevel pinion which is driven by its mating gear located on the magneto drive shaft, at the ratio of 1 to 2. The drive shaft carries the usual 17-tooth drive coupling member which is internally serrated and fitted over a similarly serrated portion of the magneto drive shaft. These parts have 45 serrations, which in combination with the 17 teeth of the coupling member permit drive coupling adjustments as fine as 2°. Thomas A. Edison, Inc., West Orange, N.J.

Tropical Problems in Aerial-Camera Maintenance

Corrosion- and rust-preventive finishes are now provided on nearly all metal parts of aerial cameras as the result of long research into tropical fungus and moisture conditions.

The aerial cameras, as a general rule, are large, heavy machines weighing approximately 60 to 70 lbs. They are constructed mainly of aluminum and magnesium, with the small, critical inside mechanical parts composed of steel. The cameras are electrically operated so that they wind and trip automatically, and are constructed to hold large rolls of film, sufficient for several hundred exposures. Lenses are large and heavy, and in many cases are cemented together with balsam or methacrylate cement. Certain models incorporate electrical heating elements consisting of extremely fine resistance wires that carry the electric current to heat the equipment at high altitudes and low temperatures. Electrically heated cameras have insulated linings of cork and tin foil to help retain the heat. A photo cell unit is used with one model to control the shutter trip action.

The consistently high humidity and heat of the tropics causes the surfaces of the aluminum and magnesium castings, when not protected by anodizing or special paint, to corrode readily unless the surfaces are cleaned often. This corrosion takes the form of greenish residue which gradually pits the surface of the metal.

Because some of the units, notably the shutter and magazine drive mechanisms, are covered and are fairly airtight, condensation forms on the inside of the housing when the cameras are taken to high altitudes, thus causing the steel inside parts to rust.

If cameras are left on the ground for a period, the humid, warm air gradually seeps into the shutter and drive housings, and is carried aloft with the camera on high-altitude missions. The rapid change to low temperature and low humidity causes condensation when the cold air comes in contact with the warm, moist air in the units, and moisture forms on the steel inside parts. The rust caused by this condensation usually goes undetected until a breakdown occurs, because ordinarily the housing covers could not be removed.

In order to keep the cameras in the field in proper condition at the outset of the war, the Fairchild company set up a comprehensive service department, with camera technicians stationed in every battle area and with every photo reconnaissance squadron, instructing the men in methods of combating moisture and fungus. In addition, the servicemen provided cameras with cork linings and removed the insulation.

As a result of their work, the servicemen formulated remedies. One of the best solutions to the moisture problem was found to be the hot room or hot locker for storing the equipment. All through the tropical areas of the world the servicemen have constructed small buildings of light board, and installed rows of electric light bulbs or some type of electric heaters in the rooms. The rooms are kept as airtight as possible, with a vent in the roof, and by holding the humidity at less than 40 per cent the corrosion, rust, and fungus are cut to a minimum. This procedure is highly recommended for the storage of any optical equipment in the tropics.

On the basis of the field men's reports, base plates and heating surfaces of camera magazines, which used to be bare aluminum and magnesium, are now anodized and dichromated. Steel plates are cadmiumplated wherever possible. Only the most critical heat-treated parts are not cadmium plated because of the impossibility of machining them to proper tolerances when plated. These parts, however, are in

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Tel-air
means ACCURACY

When the Lockheed Constellation made its recent record flight across the country, every *second* of the time every moving part depended on the accuracy of its manufacture to keep going at its highest point of efficiency. And when, as in the illustration above, a sister Constellation loads 100 fully equipped American Soldiers for transport to the battle front, *every* moving part on that plane must function efficiently too, to within one $^{10}/_{1000}$ part of an inch or less.

Precision manufacture of airplane parts by Tel-Air means just what it says—our record on the most rigid inspection by Army and Navy is $99^{98}/_{100}\%$ acceptance.

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If precision parts enter into your post war plans, remember—*Tel-Air parts do not fail.* Your own blue prints and specifications will have our immediate attention.

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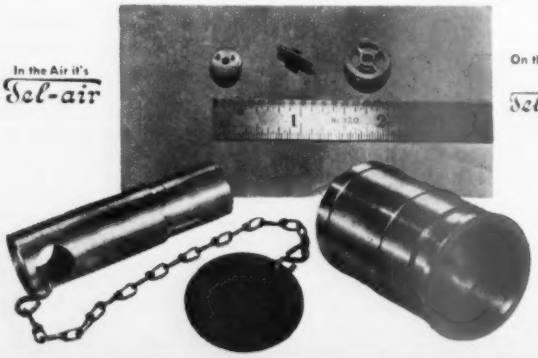

In the Air it's Tel-air

On the Highway it's Teleoptic

The TELEOPTIC Company
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the minority, and can be carefully watched for rust formation.

Tested glues are now being used in place of the old animal glues, and heavy felt padding has been eliminated from carrying cases and trunks to prevent retention of moisture and the growth of fungus. Cork linings have been eliminated from heated cameras, and an outer jacket constructed of fiber glass, which has been tested for its fungus-resistant properties, has been substituted. Fairchild Camera and Instrument Corporation, New York.

Fine Adjustment Height Gauge

Model 1492 fine-adjustment height gauge is furnished with the Testmaster indicator, a fine-adjustment bracket, and an 18-in. stand. The range of the indicator is 0.030 in. and it can be set at any angle or position. The bracket is spring-supported to prevent lost motion or backlash and it has a slide brake to prevent dropping it when unclamped. Two models of the Testmaster are offered, graduated for 0.001 in. or 0.0001 in., and metric scales are available. The height gauge may be purchased without the Testmaster. The fine-adjustment bracket is also sold separately for use with any height gauge having an upright measuring $1^1/_4$ in. by $^1/_4$ in. Federal Products Corporation, Providence, R.I.

Emulsifying Degreasant

G-BEX 45-A is a new emulsifying degreasant which is reported to possess the unusual characteristic in that it gains in strength with dilution. Despite its powerful detergent action, it will not corrode metals or harm the skin. The alkaline factor of this compound is pH-7 (neutral) and its flash point is 150°F.

It is recommended by the manufacturer for cleaning, degreasing, and dewaxing of machines, motors, equipment, and parts that are being processed prior to finishing or assembling. It may be applied with a brush or spray gun. It may also be used in standard emulsion-degreasing tanks, either cold or heated. When the dirt, oil, and grease are thoroughly saturated, they are removed by flushing or hosing with water. A trace of the residual compound minimizes the tendency to rust after the washing process.

The compound is packed in $7^1/_2$- and 50-gal. drums and is available in commercial quantities in either concentrate (45-A) or ready-to-use form (G-BEX "D"). Gaybex Corporation, Nutley, N.J.

Smallest Six-Element Oscillograph

An oscillograph believed to be little more than half the size and weight of any six-element unit ever before built was designed for tests on war devices. The unit can record simultaneously six different measurements—for example, the vibratory motion of stresses set up in such parts as struts during the flight of a plane, or current and voltage performance of various types of electric

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Will be equipped to serve you with these Facilities

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The Pollak Company maintains an experienced and versatile technical staff for research, development and designing of products and for manufacturing methods.

Blanking, Stamping, Drawing operations ranging from very small precision work to medium heavy work. Maximum depth of draw, 11½"; maximum diameter of shallow stamping, about 45". Materials worked: carbon steel, stainless steel, brass, bronze, monel metal, inconel, aluminum and strong aluminum alloys.

Sheet Metal Fabricating from the lightest to ½" in steel and ¼" in aluminum, including tanks and process vessels of all the corrosion resistant metals.

Welding and Brazing by oxy-acetylene, oxy-hydrogen and electric arc processes, specializing in the more difficult alloys.

Electric Spot-Welding and Seam Welding, ranging from very light work to ¼" material in steel and to ⅛" material in aluminum.

Hand Screw Machine Work from the smallest to 3¼" diameter bar.

Multi-spindle Automatic Screw Machine Work from the smallest to 2⅝" diameter bar.

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Electrical Coil Windings of various kinds ranging from small to medium size.

Mechanical and Electrical Assembly ranging from very small precision work to medium heavy. (About one ton per unit is the heaviest ordinarily desired.)

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FIVE FULLY EQUIPPED PLANTS with over 4500 employees are now serving our Armed Services. But fully staffed engineering development and post-war planning departments are at your service. They will work with your sales and engineering groups now to help plan your future production at your request.

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The original Army-Navy "E" award to this company has been renewed four times. Each of the four stars on this flag symbolizes six months of exacting service to our Armed Forces.

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equipment. It is also adapted for making electrical and mechanical tests on ships, in power systems, and in industry.

Each of the six circuits to be measured enters at the right where its characteristics are translated into six different beams of light. Each beam registers as a thin line on the photographic paper rolled up at the left, thus forming a permanent, composite record. General Electric Company.

Umbrella-Type Assembly Bench

The use of a new umbrella-type bench, supported by centrally located legs instead of the usual two outside legs placed at regular intervals along the conventional type bench, has resulted in a 30 per cent improvement in the utilization of working space at assembly and testing benches. Operators may now be placed anywhere along the benches with no interference from legs that were formerly in the way.

The benches are 2 ft. 8 in. high, 22 in. wide, and are constructed entirely of metal with Masonite coverings over the sheet-steel tops. The legs, cut from 3-in. standard channel steel, are each welded to a 4 by 16-in. base and supported by a 4 by 10-in. upright angle cut from $^3/_8$-in steel plates. Two holes are drilled in each base to accommodate floor bolts. The legs are welded to the table top and supported by means of two $^1/_4$ by $1^1/_4$ by 8-in. iron straps.

The elimination of half the legs and stringers required for the old-type benches, and the reduction in the width of the top, has reduced the cost considerably because only about half the metal is used. The labor cost also has been reduced since there is less welding, cutting, and bending to be done, and it is of a simpler nature. In addition, it is much easier to keep the area around the benches clean.

The 22-in. table-top width may seem quite small but there is sufficient space for the necessary tools and equipment without crowding the working area. There is, however, no excess space for the accumulation of unnecessary boxes, lockers, defective parts, and other articles that decrease working efficiency, waste valuable space, and add to a generally untidy appearance. General Electric Company.

Portable Radio Tower

The Bantam King is a portable square steel tower for radio and other uses, made up of uniform sections, that can be erected without the need for skilled riggers.

It is available in heights of 30, 50, and 100 ft., or intermediate multiples of six ft. The sections are 4 ft. square and 6 ft. in height. One side of a 6-ft. section consisting of two posts, one horizontal channel, and two diagonal flats is assembled on the ground and lifted to the proper height. This one side of a section weighs only 28 lbs. and the entire 6-ft.-square section totals 112 lbs.

After setting the four corner base plates, the first sectional unit is fastened to the base with three bolts at each corner post. Adjustment of these bolts provides an accurate starting level. This accomplished, a similar process of construction is repeated for each section until completed. The 30-ft. tower can be erected by three men in 2 hours. Regardless of the height of the tower, all the channels and flats are identical and interchangeable. The posts are identical and each post is inserted in the upper end of the post below. It is not necessary to bolt the posts together. The connection is complete after the diagonal bracing is bolted in place, which is secured at one end to the top of the upper post and at the other end to the top of the lower post on the opposite side. A gusset plate acts as a connection for the horizontal channel, the diagonal bracing above, and the diagonal bracing below. All posts are sealed with a flat washer at both ends so that there is a direct bearing at this point of contact. No rivets are used. The tower is of all-welded construction except for the bolts used to make the field connections. On each 6-ft. section there are 24 connections.

The tower was designed for a vertical load of 500 lbs. and a horizontal load of of 420 lbs., concentrated at a point 6 ft. above the top of the tower, in addition to a wind velocity of 100 m.p.h. When tested with these loads, the deflection at the top of the tower was less than 1 in.

The tower supports a 4 by 8-ft. platform of $1^1/_4$-in. wood planks enclosed by a railing 3 ft. in height. One of the horizontal members is hinged and forms a gate for access to the platform. The 30-ft. tower, exclusive of base, ladders, platform, boom, winch, etc., weighs only 596 lbs. and occupies a shipping space of only 8 cu.ft. Under the same conditions the 50-ft. tower weighs 998 lbs. and occupies 14 cu.ft. A 100-ft. tower would weigh 2,154 lbs. and occupy 30 cu.ft. A winch and boom are included in the accessories, making it possible to lift apparatus weighing as much as 500 lbs. to the platform. The curved-neck boom is attached to the top 6-ft. section, extending 8 ft. above the top of the platform. A worm-geared winch with cable is attached to the boom. When apparatus is raised to the proper height, the boom is rotated 180°, placing the apparatus directly above the platform. Harco Steel Construction Company, Inc., Elizabeth, N.J.

Portable Aircraft Heater

A portable, lightweight heater of high capacity, developed with the cooperation of the Navy Bureau of Aeronautics and the Army Air Forces Matériel Command, has an output of 275,000 minimum to 300,000 maximum B.t.u. per hour. It burns either high-octane gasoline or fuel oil and has automatic electric ignition.

Operation is by a lightweight gasoline engine running in a compartment that may be closed as desired, with controllable heat directed to carburetor and crankcase to assure uninterrupted operation even under extreme conditions. Should an emergency change of power plants be required during critical aircraft-heating operations, the entire power plant may be removed by one man in 30 sec., and another installed in less than 2 min. No wrenches are required for this change because the heater has a quickly detachable, multiple fuel-line joint, and hand-operated bed clamps. The entire unit is enclosed in a stormproof, insulated jacket and is mounted on rubber-tired wheels. The wheels are instantly retractable or may be removed in 10 sec. The bottom has sled runners for easy passage over ice, snow, or soft ground. Another feature is a rack at the top for quick storage of ducts.

When changing from one aircraft to another during preflight heating operations, the ducts may be folded back into the rack without disconnecting them from the heater, facilitating transfer from one aircraft to the next. Two 12-in. ducts may be fitted, or six 6-in. ducts as required. Generation of heat is by the indirect method, therefore it is nontoxic, making the unit suitable for a variety of other uses, such as heating of large aircraft cabins prior to flight, aircraft tents during servicing operations, troop barracks, field offices, and for drying operations in parachute packing, etc. Harvey-Whipple, Inc., Springfield, Mass.

Grooving and Cutoff Tools

Grooving tools of Haynes Stellite cobalt-base alloy are finish-ground and lapped to specified tolerances. Cutoff tools are ground to size but not lapped unless specified by purchaser. Both types of tools may be obtained in either 98M2 or Star J-Metal alloy, with 98M2 especially recommended by the makers for steel.

Grooving tools are furnished in three types—plain, channel, and I-beam—for grooving operations on cast iron, aluminum, brass, bronze, and steel. The side lands are lapped to give maximum tool life. To resharpen these tools it is necessary only to grind the cutting end, maintaining the front clearance angle.

Cutoff tools are made in two styles, identified as Style 1 and Style 2. Both styles are of the double-bevel type, the tapered sides providing side cutting clearances. A 6° angle is incorporated in the top and bottom edge of Style 2 to make it adaptable to certain cutoff-tool holders. Both styles are suitable for cutoff operations on tubing, cylinders, or hollow forgings of iron, brass, bronze, aluminum, and some types of steel. Haynes Stellite Company, Kokomo, Ind., a unit of Union Carbide and Carbon Corporation.

High-Lift Truck for Cargo Loading

By borrowing ideas from familiar civilian sources and redesigning them for Army Air Forces' use, the Engineering Division's Equipment Laboratory at the Matériel Command, Wright Field, has developed a piece of airborne equipment that has solved the Army Air Forces' cargo-loading problem. It is a kit that gives a standard Army truck a high-lift body, elevated by scissors mechanism.

UNITED STATES RUBBER COMPANY

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THE SKYFREIGHTER WEIGHS IN!

NEWEST addition to American Airlines Flagship Fleet is the Skyfreighter, carrying a useful load of 8826 pounds over American's transcontinental route.

The Skyfreighters are among the twenty-five planes now being returned to American Airlines by the Army and are actually the Flagship Skysleepers which the Army took over in the spring of 1942. They have been put through a complete conversion program by American to provide facilities best adapted to carrying cargo based upon American's long experience as an air cargo carrier.

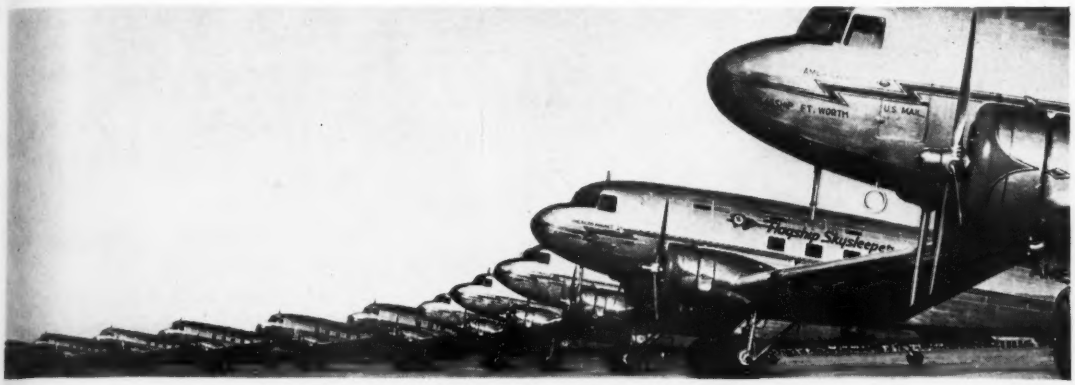
Here a Skyfreighter is officially weighed-in before she starts on her maiden flight. With scales under each of the landing wheels and another at the point from which the ship is suspended, the job is done quickly and easily. Regular weighing is important because airplanes, too, grow heavier as they grow older.

From July, 1941 to June, 1944 the average useful load carried by American Airlines Flagships has increased more than 50%. This extra load, made up of passengers and cargo, means extra work for tires. It makes tire quality and tire care more important than ever.

BY READING THE WEIGHTS recorded under each landing wheel and at the point of suspension, the total is quickly calculated. With every ounce of pay load needed for wartime cargo, accurate weighing is more than ever necessary.

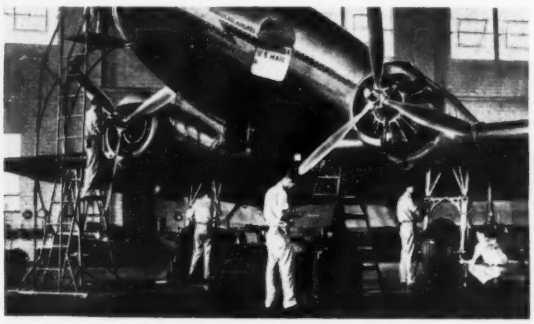
1230 SIXTH AVENUE **UNITED STATES**

HOW AMERICAN AIRLINES CONSERVES TIRES WHILE ITS 50 PLANES DO THE WORK OF 82!

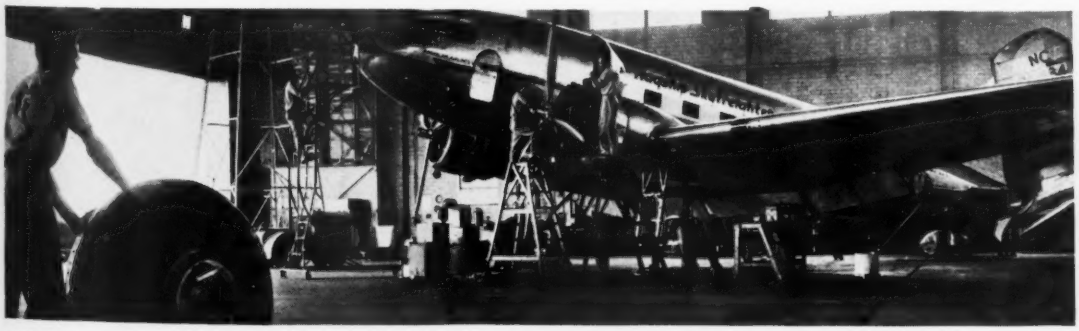


IN JULY, 1941, American Airlines operated 82 planes, a daily average of 7 hours and 39 minutes. In June, 1944, the Flagship Fleet consisted of 50 planes, with each plane scheduled for 13 hours active service every day. In 1941, the 82 planes turned in 605 hours of scheduled service. In 1944, the 50 planes worked 650 hours. That's one big reason why American has a maintenance department of over 3000 men and women...to keep the Flagship Fleet always at peak efficiency.

SERVICE INSPECTION...Whenever a Flagship rolls up to an American Airlines Terminal, one of the regular procedures followed by the ground crew is to give the tires the "once over" and report any signs of trouble at once.



LINE (OR BASE) INSPECTION...When the Flagship reaches its final terminal for the day, radio equipment, fuel and oil are checked. Landing gear, fuel, hydraulic and electrical systems and other vital parts are inspected.



GENERAL INSPECTION...At general inspection, every Flagship is checked over to the last detail by expert mechanics skilled in each specialized operation. Wheels are removed and tires, brakes and axles inspected. Where necessary, tires are removed and checked inside and out. Injured tires are returned to the manufacturer for repair. Smooth tires are returned for new treads. Under this carefully organized and rigidly supervised procedure tire failures at American are practically a thing of the past.

RUBBER COMPANY ROCKEFELLER CENTER · NEW YORK 20, N. Y.

WITH FLAGSHIPS LANDING on an average of once every hour instead of once in two hours and with pay loads 50% greater than in 1941, these U. S. Royal Airplane tires have a bigger job to do than ever before—and they are doing it!

Life Line
OF A U. S. ROYAL
on the Flagship Fleet

Every tire that ever flew on an American Airlines Flagship has its own life line or Tire Log filed away where it can be referred to instantly. From the day that a 17.00 x 16 U. S. Royal Airplane tire is mounted on a Flagship until it is removed for recapping and finally discarded after having given its full service, the Maintenance Division of American Airlines keeps its life history hour by hour and plane by plane.

As synthetic rubber airplane tires with bodies of rayon replace natural rubber tires, the backlog of test experience already accumulated by American and recorded on Tire Logs will be of vital importance to airplane tire manufacturers. Benefiting from data like this, U. S. Airplane Tire engineers are finding new and better methods and materials to build lighter, stronger, safer tires.

IN THE RECORD SECTION of American's Maintenance Department, every tire has its own Tire Log. From the ship's log, the record clerk transposes each step in the tire's life from original installation to final removal.

THIS IS THE LIFE LINE of a U. S. Royal that made better than 700 landings before it was sent to the "U. S." Tire Factory at Detroit for recapping. If the tire body is still in good condition, a new tread will be applied and the tire put back in service.

THERE IS A TIRE LOG on file for every tire that ever flew on an American Airlines Flagship. From these records, data are supplied to airplane tire makers helping them to design stronger airplane tires to carry the greater loads of today and tomorrow.

SERVING THROUGH SCIENCE TO SPEED THE VICTORY

UNITED STATES RUBBER COMPANY

1230 SIXTH AVENUE • ROCKEFELLER CENTER • NEW YORK 20, N. Y.

THE FUTURE IS OFTEN AS CLEAR AS A SUMMER NIGHT

Facts show the Constellation to be a superior airplane. Its importance, however, derives more from its significant place in the history of flight. For there are rare moments when the ingenuity of the drafting boards and the skills of the benches combine perfectly, swiftly accelerating the steady pace of progress. And at these moments, the future becomes as clear and star-filled as a summer night—a future that in this instance pledges ever greater planes to come, ever wider horizons, and a true bond of understanding among the peoples of the earth.

The Lockheed Constellation

Highest speed of any transport
Greatest rate of climb of any transport
Largest load-carrying capacity of any transport
Longest range of any transport
And these performance factors make
the Constellation the *safest* of any transport.

FOR NEW WORLD STANDARDS IN AIR TRANSPORTATION

LOOK TO LOCKHEED FOR LEADERSHIP

Lockheed Aircraft Corporation, Burbank, California

Someone has to KNOW

COMPARATIVE BONDING QUALITIES OF RUBBER AND VARIOUS SYNTHETIC RUBBERS

Materials	Natural Rubber	Reclaim Rubber	Buna "S"	Buna "N"	Neoprene	Thiokol
Aluminum 2S and 3S	Good	Good	Fair	Good	Good	Poor
Black Iron	Good	Good	Good	Good	Good	.....*
Brass 70/30 or less	Good	Good	Good	Good	Good	Fair
Bronze	Poor	Poor	Poor	Poor	Poor	Poor
Cadmium Plate	Good	Good	Good	Good	Good	.....*
Cast Iron	Good	Good	Good	Good	Good	Fair
Chromium Plate	Fair	Fair	Fair	Fair	Fair	Fair
Copper	Poor	Poor	Poor	Poor	Poor	Poor
Dow Metal	Good	Good	Good	Good	Good	Good
Galvanized Iron	Poor	Poor	Poor	Fair	Good	.....*
Lead	Good	Good	Good	Good	Good	Good
Stainless Steel	Fair	Fair	Fair	Fair	Fair	Fair
Steel	Good	Good	Good	Good	Good	Fair
Carbon	Good	Good	Good	Good	Good	.....*
Wood	Good	Good	Good	Good	Good	.....*
Celotex	Good	Good	Good	Good	Good	Good

NOTE: ORCO engineers are conducting additional tests on these materials. Complete information on all materials listed and many others is obtainable upon specific inquiry.

In planning the design, construction and operating efficiencies of machinery of all descriptions, where rubber and synthetic rubber must be bonded to metals and other materials, *someone has to KNOW* the adhesion qualities of the specified materials.

The above chart summarizes the results of exhaustive tests conducted by ORCO engineers on the bonding qualities of the indicated materials.

Limitations of space make it impossible to list the multitude of materials on which factual information on adhesion qualities is available from ORCO engineers.

This storehouse of accumulated experience is available to YOU. It is part of what we term "ORCO-OPERATION".

"ORCO-OPERATION"

THE OHIO RUBBER COMPANY · WILLOUGHBY, OHIO

BRANCHES: DETROIT · NEW YORK · CHICAGO · INDIANAPOLIS · WASHINGTON · CLEVELAND

New Hi-Lift plane loader built for United Air Lines by The Heil Company lifts 3 tons of express smoothly to front cargo door level, drops its forward ramp, and is ready to load.

The kit, which converts a standard Army $2^1/_2$-ton, six by six truck into a high-lift truck, weighs only 1,600 lbs. and is designed to be shipped by air to advanced bases. Army trucks of this type are usually present at advanced air bases and with this kit can be converted into high-lift trucks by a normal crew in less than a day. The high-lift truck works like a coal truck, the body of which is lifted by scissor members.

The high-lift truck kit, as it is received by A.A.F. mechanics, consists of a sub-frame with scissors-type lifting members, twin hydraulic hoists, pump and valve, power take-off and operating lever, pump-drive shaft with universal joints, valve-operating lever and connecting rod, body attaching brackets, special cargo-loading tail-gate (which serves as a ramp), and telescoping floodlights with wiring.

The high-lift cargo plane loader can operate in every type of terrain from mud and sand to ice and snow. It has loading space of 12 ft. by 7 ft., which in most cases allows it to carry a full plane load in one trip. It is rated at 5,000 lbs. with a 100 per cent overload factor. The two floodlights that fit on the rear corners of the high-lift body facilitate loading at night. The low position of this truck is $4^1/_2$ ft. and the high position is 10 ft. The Heil Company, Milwaukee.

Synthetic Rubber Stock for Oil Resistance

A new Buna N fuel-resistant stock (233–5), is reported to be able to retain a tensile strength of over 1,000 lbs. per sq.in. and elongation of over 100 per cent after being subjected to aircraft engine oil at 300°F. for a period of 70 hours.

This Buna N stock was designed for oil seals, oil rings, and other applications requiring resistance to aromatic fuels. It is also stated that it remains flexible at −40°F. and has a very low compression set. Los Angeles Standard Rubber Company, Los Angeles.

Plastic Junction Box

A new type plastic electric junction box that is considerably lighter and easier to assemble and maintain than the standard boxes now in use has been developed and will soon make its appearance in forthcoming Martin models.

The new box reverses present practice by using a flat plate as the main section to which installations and wiring are attached, and a molded cover of Plexiglas or some other transparent plastic. With the type of box now in use, all installations are made in the box proper where they are far less accessible during assembly and maintenance than on the new unobstructed flat surface.

Another time-saving improvement made possible by the new design is the sensitizing of the base plate and the reproduction thereon, by a photographic process, of the wire-flow diagram. This not only greatly simplifies drilling, assembly, and wiring of the boxes in the factory, but in addition provides a permanent record for the use of field service men.

The Glenn L. Martin Company's new-type plastic electric junction box.

The design of the new box allows for the use of either a metal or laminated plastic base, depending on whether or not ground studs are needed in the assembly. The transparent cover requires only a single, low-cost, cavity mold. The actual forming is done by air from a flat sheet heated to 380°F.

The transparency of the cover adds still further to the time savings that the new-type box will make possible, both during manufacture and in the field. Today for example, with the old-type metal box now in use in the center-wing section of the PBM-3 Mariner, it is necessary to remove and replace the cover 23 times for visual inspections between the original installation and the turning of the airplane over to ground test. This operation is repeated countless additional times in the field, but with the transparent cover it can be eliminated.

Savings of weight as well as of time with the new box will be considerable, ranging as high as 33 per cent per box depending on the type of box and the material from which the base is made. While present plans call for introducing the new design only in the radio direction-finder junction box, the design is equally applicable to all other junction boxes in the airplane. In the case of a plane similar to the PBM-3 Mariner, which uses approximately 100 boxes in its various electrical systems, this would result in a net weight saving of 35 to 40 lbs., as well as a marked reduction in material and manufacturing costs. Even greater savings are possible in larger airplanes such as the JRM-1 Mars. The Glenn L. Martin Company.

Mariners Converted for Transport Service

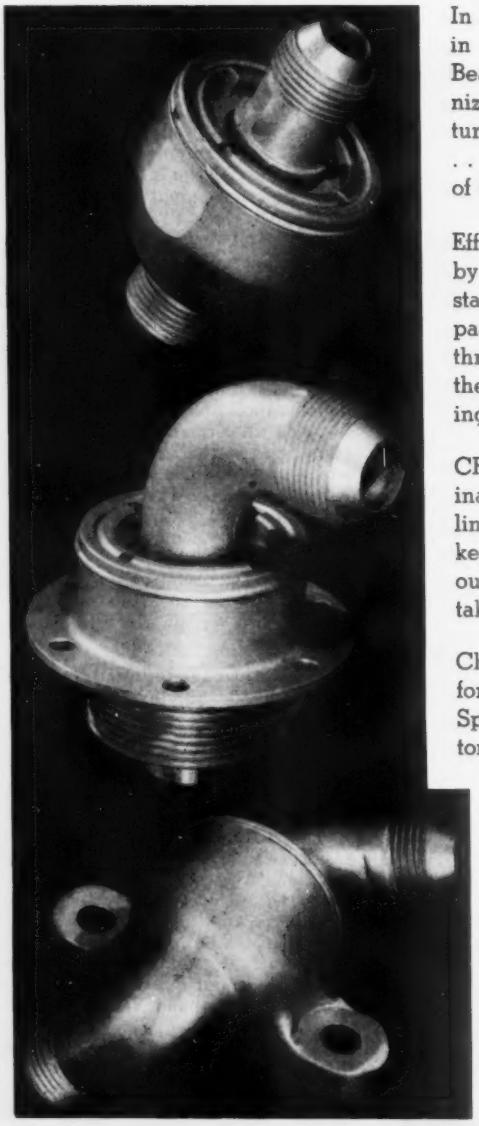
The operational flexibility of the Martin PBM-3R Merchant Mariners used by Air Transport Squadron 8 is exemplified by their adaptability to combined passenger and cargo service. Several different interior arrangements have been tried experimentally, with that now used for the run to Natal, Brazil, having either five or ten air-line type seats and 22 collapsible bucket seats that can be folded back to make room for cargo. All planes are equipped with galleys, and hot meals are served between Trinidad and Natal.

The ratio of passengers to cargo depends on which type of service requires the space more urgently. As many as 40 passengers can be carried between Patuxent, Maryland, and Bermuda, in addition to the crew of seven, but to date the record passenger load is 33. The average load on this run is more likely to consist of 5 passengers and 6,800 lbs. of mail and cargo.

Just as the ratio of passengers to cargo can be varied to meet different

CHIKSAN

Ball Bearing HYDRAULIC SWIVELS for AIRCRAFT



In the testing laboratory and in the air, CHIKSAN Ball Bearing Swivels are recognized for their smooth, easy turning with lowest torque . . . under all rated extremes of temperature and pressure.

Efficient operation is assured by steel ball bearings and standard AN "winterized" packing. All radial and thrust loads are absorbed by the ball bearings. The packing unit is self-adjusting.

CHIKSAN'S low torque eliminates heavy stresses on pipe lines and connections and keeps them from being forced out of alignment as movement takes place.

Chiksan Ball Bearing Swivels for Aircraft are built to AN Specifications and are custom-built to manufacturer's and designer's designs. They are supplied with either AN or other special end connections.

FOR ENGINEERING DATA ADDRESS DEPT. AER

CHIKSAN TOOL COMPANY

TRADE MARK REG

BALL BEARING SWING JOINTS for ALL PURPOSES

BREA, CALIFORNIA

conditions, so the total pay load varies on different legs of the trip from a low of 6,000 lbs. on the Belem-Trinidad run to a high of 9,000 lbs. on the Trinidad-Georgetown run. This difference arises from the varying length of the run and the distance between emergency landing points. Safety is a paramount consideration in the Squadron VR-8 operation, and sufficient fuel is carried at all times to permit single-engine operation from the midpoint of the flight. How this has worked out is demonstrated by the fact that the squadron has never lost a Mariner in three-quarters of a million miles of transport operation, despite the fact that nine single-engine approaches and landings have been made since January 1.

The PBM's used by VR-8 are all converted patrol bombers that saw many hours of combat and training service before being assigned to the squadron. Two of them were on patrol duty in the Carribbean and South Atlantic, another was a combat trainer at Banana River, and the three most recent acquisitions were returned by the R.A.F. under reverse Lend-Lease.

The VR-8 Mariners have high standards of economy as well as dependability. Actual figures vary with the length of the trip, but operating at 55 per cent of rated horsepower, ton-mile-per-gallon figures of better than 4.86 on shorter flights and 3.24 on long over-water trips, and ton-mile-per-hour figures of 629 for shorter runs and 486 for long flights, have been recorded.

Air Transport Squadron 8's operational training activities are not confined to its transport routes. Many hours of ground study and specialized flight training are put in at Patuxent, and crews from this squadron have ferried many Mariners to the Pacific. The Glenn L. Martin Company.

Modifications for Roll Forming Machine

Modifications for the standard Farnham roll forming machine developed in the Tool Design Department of The Glenn L. Martin Company have not only tripled the productivity of this equipment used to produce cylindrical contours in heat-treated aluminum-alloy sheet, but in addition have reduced scraps to zero and simplified the operation sufficiently to permit the use of semiskilled operators.

There are three principal changes. Foot switches have been substituted for the old rope control to stop, start, and reverse the motor. A solenoid brake has been added to permit instantaneous stopping at any point. Remote safety-stop and lock-out buttons have been installed at convenient points over the length of the machine to permit its safe use by more than one operator.

The foot switch is of an exclusive Martin design and is used in large quantities throughout the company's manufacturing operations. Its salient features are: (1) The operating pedal is very close to the floor level, permitting the operator to keep both feet firmly on the ground and operate the switch with

LOW TEMPERATURES

...and how their embrittling effect on metal parts can be avoided

Today, when choosing a metal for critical aircraft applications, a new factor must be considered...

The effects of intense cold on its properties.

The most common trouble comes, of course, from *brittleness.*

To avoid it, metals need high ductility and toughness, not only at ground-level temperatures but in the sub-zero cold of the sub-stratosphere.

As this ductility and toughness, in turn, must usually be coupled with other properties of strength, hardness, corrosion-resistance, etc., the problem resolves itself into finding a material that combines *all* the desired properties.

This is exactly the reason why the INCO Nickel Alloys are especially useful for parts to withstand sub-zero temperatures. In addition to their strength and resistance to corrosion, these metals exhibit a unique and valuable characteristic: *Instead of becoming brittle they retain their high toughness values as their strength and hardness increase.*

This is in marked contrast to the results observed with many other engineering materials which, while retaining reasonable tensile strength, grow increasingly brittle as the temperature drops.

High Properties at Low Temperatures

The tensile strength of the high-nickel alloys at normal temperatures, for instance, is equal or superior to that of many steels. This strength and hardness actually increase as the temperature skids down into the sub-zero range. (See table below).

The important factor of *freedom from brittleness* is illustrated by the results of Charpy impact tests. Here, the normally high impact strength of nickel at ordinary temperatures actually increases an average of 10% at −110° F. Inconel loses slightly in ductility, but both Monel and "K" Monel retain substantially the same high impact rating.

Non-Magnetic Properties

Three of the high-nickel alloys are non-magnetic at sub-zero temperatures. (See Table).

Consideration of non-magnetic characteristics along with strength and ductility turns the spotlight immediately on "K" Monel. This alloy can be age-hardened and will remain non-magnetic to as low as −150° F. Severe cold work and age hardening do not change its non-magnetic characteristics.

A typical application is in the Sperry Horizon Instrument. Here the *combined* strength, ductility, corrosion-resistance and non-magnetic properties of "K" Monel single it out as the ideal material for long, accurate service.

* * *

For further information regarding the properties and working of INCO Nickel Alloys, write for a copy of the booklet "INCO Nickel Alloys for the Aircraft Industry." A copy is yours for the asking. Address:

Magnetic Properties

Material	Magnetic Transformation Temperature (Curie Point) °F at Permeability of 1.02 max.	Permeability at Room Temperature H = 1 Oersted	Permeability at Room Temperature H = 200 Oersted
"K" Monel	minus 150	less than 1.02	1.0015
"H" Monel	minus 70	less than 1.02	1.002
Inconel	minus 40	less than 1.02	1.005
Monel	110–130	25	15
Nickel	680	120	30
Iron	1410	5000	100

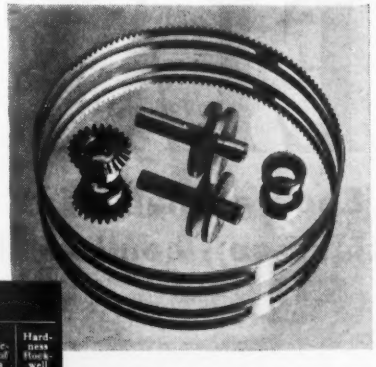
Summary of Effect of Low Temperatures on Nickel and High-Nickel Alloys

Increase with Decreasing Temperature	Remain Unchanged with Decreasing Temperature	Decrease with Decreasing Temperature
Tensile strength Yield strength Proof stress Proportional limit Tensile modulus Torsional modulus Brinell hardness Fatigue life (for a given load) Elongation	Reduction of area Impact strength	Length

Mechanical Properties at Low Temperatures*

Material	Condition	Temperature °F	Yield Strength (0.2% offset) psi.	Tensile Strength psi.	Elongation in 2 in. per cent	Reduction of Area per cent	Hardness Rockwell C
Monel	Cold-drawn	Room	93,700	103,800	19.0	71.0	19
	Cold-drawn	−110	110,850	117,400	21.8	70.2	25
	Cold-drawn†	Room†	91,500	103,400	17.1	72.5	21
Nickel	Cold-drawn	Room	97,100	111,000	16.3	66.9	19
	Cold-drawn	−110	101,900	132,500	31.5	60.9	22
	Cold-drawn	Room†	93,250	102,700	16.3	69.2	20
Inconel	Annealed	Room	50,800	93,800	47.3	64.1	82B
	Annealed	−110	52,000	106,400	49.6	64.0	87B
	Annealed	Room†	50,200	93,000	46.5	64.4	82B
	Cold-drawn‡	Room	117,700	124,100	7.0	49.3	31
	Cold-drawn‡	−110	154,900	163,900	9.8	51.2	36
	Cold-drawn‡	Room†	147,400	151,900	7.3	49.3	32
"K" Monel	Cold-drawn, age-hardened	Room	125,900	157,300	15.5	37.4	33
	Cold-drawn, age-hardened	−110	134,600	171,550	17.3	41.1	38
	Cold-drawn, age-hardened	Room†	125,850	157,350	14.8	37.2	33

* Bureau of Standards Report, June 14, 1937.
† Annealed and held at −110° F. for several hours prior to testing at room temperature.
‡ 30 per cent reduction in cross-sectional area by cold drawing.



PARTS FOR SPERRY HORIZON INSTRUMENT. Tough, strong, *non-magnetic* "K" Monel assures accuracy... longer life. These parts are machined soft, then heat-treated for maximum strength and hardness.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL ST., NEW YORK 5, N. Y.

STRUTHERS-DUNN
INC.

5,288
TYPES OF

RELAYS

Each available in
countless coil combinations

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DISTRICT ENGINEERING OFFICES: ATLANTA • BALTIMORE • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND
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his toes. (2) The electrical mechanism consists merely of a standard microswitch, inexpensive, easily replaceable, accurate, and requiring low pressure and travel to operate. (3) All moving parts of the switch are balanced dynamically so that sudden shocks or movements will not produce undesired operation. (4) All moving parts are supported on ball bearings to reduce friction and wear. (5) The switch housing has an integral safety cover made of heavy gauge welded steel plate to prevent undesired or accidental operation, is extremely rugged, and will withstand severe abuse.

Since installation of the modifications, no accidents have been reported on the machines. Scrap losses have been reduced to zero because of the ease of accurate stopping; production speed has been increased to three times what it previously was; and the degree of skill required for the job has been substantially reduced. The cost of the modifications is relatively low since all necessary parts are available in the average maintenance shop, and the installation procedure requires four simple steps. The Glenn L. Martin Company.

New Windows for the Mariner

The "showcase" type of window is now being used for the pilot's cabin of the PBM Mariner, to provide greater protection and ease of operation. The new installation, which replaces a two-panel device, consists of a single waterproof window that slides back and forth like the front of a showcase, in a track made up of two channel sections lined with Schlegel cloth. It requires a minimum number of operating and locking devices.

The window is a sheet of glass with two vertical 0.0359-in. steel channel sections clamped fore and aft over thin layers of Everseal filler. The handle is a glass block, $^3/_4$ by $^5/_8$ by $2^1/_2$ in., attached directly to the glass by a Vinyl adhesive. A small steel knob welded to the lower inside corner of the forward channel is provided to snap into a spring latch on the sill as the window is closed. The window is installed by sliding the panel into the horizontal track, then inserting strips of phenol-fiber filler and Schlegel cloth strip between the window and the upper track channel to provide a firm seat. The filler strip and Schlegel cloth are secured with countersunk bolts.

When closed and latched, the vertical channel sections of the window panel fit snugly against two or more strips of Schlegel cloth riveted to the frame. A rubber cushion attached to the vertical sill post prevents injury to the glass handle when the window is opened all the way. The Glenn L. Martin Company.

Gunner-Training Stand with Instructor's Seat

A new training stand that mounts a standard Martin electric turret and simulates many of the conditions experienced in actual combat is now being used to train aerial gunners for the Army Air Forces. Originally developed at the request of Army engineers, the new stand was designed and approved and the first unit manufactured in the Martin Experimental Department was shipped to the Army within 6 weeks of the time the original inquiry was received.

Mounting a standard turret, the new stand provides a seat and controls for an instructor whereby he is able to control the movement both of a target airplane swinging on a wire and the "bomber" on which the turret is supposedly mounted. In this way, it is possible for the instructor to provide every imaginable combination of attacking maneuvers and evasive action while the gunner compensates for them through his control of the turret. The Glenn L. Martin Company.

Printer for Cellulose Numeral Tape

Proper identification of the wires and tubes in modern airplanes has been greatly simplified by the development of a new machine for making cellulose numeral tape, the means of identification specified by the Army and Navy. With the new machine it is possible to print the tape as needed, thus removing the necessity for stocking large quantities of tape.

The tape printer itself consists of a keyed wooden take-up spool, two feed spools to hold transparent and white cellulose tape respectively, a printing roll with interchangeable hardened type permitting any number desired to be printed, and various guides and inking rolls. The entire device is powered by an air-driven motor and contained in a box $7^1/_2$ in. by 4 in. by 15 in., with the feed and take-up spools mounted on the outside.

The wooden take-up spool is placed on the drive shaft so that a key on the shaft fits into a hole in the spool. A small piece of metal ($^1/_2$ in. by $^1/_8$ in. by $^1/_4$ in.) is fitted into a groove in the wooden spool to elevate the tape. There is a corresponding groove in the drive shaft. During operation of the machine, the small metal piece elevating the tape rests against the drive shaft away from this groove and is slipped into the groove by spinning the spool on the shaft upon completion of the printing to permit easy removal of the spool of printed tape.

One-half inch transparent acetate tape is mounted on one of the feed spools on an arm at the top left-hand corner of the box in such a way that the adhesive side faces to the operator's right as the tape is pulled toward the drive shaft. As this clear tape is drawn toward the drive shaft, it passes down and to the right of two rollers which press it against the printing roller.

One-half inch white cellulose tape is mounted on a spool on the right side of the box just above the center line so that the adhesive side is facing down as it is drawn toward the drive shaft. This tape is affixed to the top side of the take-up spool with the transparent tape, on the top of which the numbering is printed.

The printing mechanism consists of 3 rollers—one of Micarta, one of rubber, and one roller holding the interchangeable type. Ink is first placed on the Micarta roller with a small brush. This is then brought into contact with the rubber roller and rotated by hand a few times to spread the ink evenly. Then both rollers are moved against the number roll and the machine is ready to operate by pressing down a lever on the left-hand side of the box which starts the air motor.

In operation the white tape backs up the numerals immediately after printing to prevent them from being smeared, while the key in the spool keeps the tape from being wound too tightly and allows it to contract with telescoping. About 15 sec. are required to print and rewind a roll of tape 3 in. in diameter. A single machine is supplying all the tape needed by one department, while another machine satisfies the demands of another plant. Twenty-one employees and supervisors representing all three shifts of the Army Division Electrical and Tubing Departments participated in the development of the Martin cellophane tape printer. The Glenn L. Martin Company.

P-61 Black Widow

Additional information has been released about the P-61 Black Widow, which was designed specifically as a night fighter. It is as large as a medium bomber and heavier than a standard air transport, weighing more than 25,000 lbs. It is powered by twin 2,000-hp. Pratt & Whitney engines with four-bladed Curtiss propellers.

The plane is manned by a crew of either two or three. Its armament consists of 20-mm. cannon and 0.50-cal. machine guns. Although its fuel capacity has not been revealed, it is stated that the P-61 has a greatly extended operational range. This enables the plane to cruise over enemy installations and airfields, and seek out hostile aircraft.

While it is extremely fast, the Black Widow is reported to be able to throttle down to very low minimum speeds, contributing an important safety factor for landing at night or in heavy fogs on small landing strips. Northrop Aircraft, Inc.

Practical Rehabilitation Work for Convalescent Soldiers

A program of vocational rehabilitation has been established in the U.S. Army's new Birmingham General Hospital at Van Nuys, Calif. Invalided soldiers are given the satisfaction and moral stimulus of doing important work on the home front by making parts for fighter planes.

Primarily the program is designed to recondition men in the hospital for return to active military duty, but for those men who cannot return to active duty it provides a means of becoming useful citizens.

A shop has been installed in the hospital. It is operated by Northrop Air-

Cannon Quality Control adds plenty to our cost of manufacturing Cannon Plugs. We can't hold to such high production standards without paying for it.

But what is it worth?

When a set of flying instruments go dead in a soupy fog, when a motor konks out in a power dive, when a plane crashes with a loss of life—it's worth a lot *to us* to know that a Cannon Plug didn't cause the trouble.

And if such assurance is worth the extra time and better materials and added inspection cost to us *how much more is it worth to the men directly involved?*

Your answer to that one is your best reason for using Cannon Plugs exclusively.

Battery Connector Bulletin lists a wide variety of Cannon Connector types for battery installation. Your copy free on request. Address Department A-105, Cannon Electric Development Co., 3209 Humboldt Street, Los Angeles 31, California.

Type AA-BR Receptacle and AA-BP Plug provide easy servicing of aircraft storage batteries

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craft, Inc., and is basically no different from any other production department, being fully equipped with machines, tools, and all the things necessary in any light-metal shop. The parts on which these wounded soldiers are working are not practice parts, but actually go into fighter planes. These men are building, assembling, and inspecting parts for the Northrop P-61 Black Widow. Even bedridden patients, who cannot get down to the shop, are doing this work. In various wards, they are busy in bed, sorting, inspecting, or assembling small parts that are very important in the building of the plane.

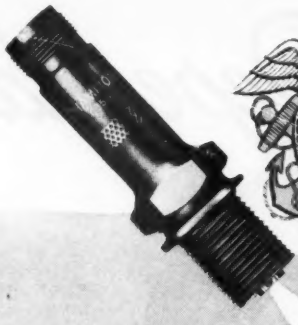
At first the men receive a short preliminary training course—generally only a week—in the theory and handling of small tools. In the classes instructors teach shop nomenclature, use of hand and bench tools, identification of materials, assembly methods, use of measuring instruments, inspection procedures, etc. When the patient completes his training, he goes into the hospital production shop where a foreman from the Northrop plant is in charge. The instruction continues. In order to give the soldiers a clear idea of how their work will be utilized, groups of them regularly visit the Northrop plant to see the actual installation of the parts they have made in the fighter planes. Northrop Aircraft, Inc.

Wind Tunnels Completed

Covering 8 acres of ground, the world's largest wind tunnel for full-scale airplane testing has been completed at Moffett Field, Calif. It was built at a cost of $7,000,000. The structure is 868 ft. in length, and has a ceiling height of 180 ft. Its width at one end is 399 ft., and 353 ft. at the other. Unlike the usual cylindrical-shaped wind tunnel, this new unit is box-shaped, with exterior bracing, leaving the interior unobstructed for air flow.

Six 37-ton, 6,000-hp. Westinghouse motors produce the blast of air that sweeps through the tunnel, each motor driving a 6-bladed fan with a diameter approximately the height of the average 4-story building. These motors send 24,000,000 cu.ft. of air through the tunnel's 2,150 ft. of closed circuit at a rate of more than 200 m.p.h., around 3,888 curved vanes at the four corners of the wind tunnel, which turn the air at right angles without turbulence.

The new tunnel is large enough for testing planes with wing spans up to 72 ft., which includes all present pursuit and fighter types, and even medium bombers. This particular tunnel is designed to test aerodynamic characteristics, such as lift and drag. By means of this type of testing, it is stated that the National Advisory Committee for Aeronautics has never failed to add at least 20 m.p.h. to the speed of an airplane about to go into production. This wind tunnel, a part of the Ames Aeronautical Laboratory at Moffett Field, is the largest of 21 of these structures built or under construction for various governmental and private agencies by the building contractor.



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As engines increase in horsepower, and the size and carrying capacity of aircraft goes up, spark plugs become more and more a determining factor in performance and dependability. Champion-Ceramic Aircraft Spark Plugs in both radio shielded and unshielded types have earned an outstanding reputation for dependability, based solely on their performance on active duty with all branches of our air forces. The primary reason for this record lies in the specially developed insulating material used in all Champion-Ceramic Aircraft Spark Plugs. This material possesses unequalled dielectric strength, exceptional resistance to heat and mechanical shock, and is practically impervious to moisture, fuel and oil absorption. As a result, the insulating properties of Champion insulators remain highly stable under the widest variation in temperatures and pressures.

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Wherever a practically indestructible, flexible, airtight conveyor is required for oil, gas or liquids; for vacuum service or for isolating vibration, it is logical to turn to American Flexible Metal Hose.

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Another project recently completed is the N.A.C.A. Altitude Wind Tunnel at Cleveland. It is the first of its kind for investigating, under altitude conditions, aircraft power plants as installed in airplanes. It is stated that it has the most complete equipment yet developed for detecting faults in entire power plants designed for high-altitude operation before the airplane goes into production.

The test section of the tunnel has a diameter of 20 ft., sufficient for testing engines of 3,000 hp. or more. The tunnel is designed to simulate sub-zero temperatures encountered at 30,000 ft., and pressures encountered at 50,000 ft. Because of the fact that power plant are operated in the tunnel, provision has to be made for cooling the air in the tunnel and disposing of the engine-exhaust gas. The installation therefore includes cooling radiators, an intake-air duct, and an exhaust-air scoop that are not normally parts of an aerodynamic wind tunnel.

The tunnel is of steel construction, using an alloy especialty adapted to temperature changes, and is supported through steel rollers on concrete piers in such a manner as to provide for movement in any direction to permit expansion and contraction of the steel shell. Heat losses are minimized by an insulating layer of glass wool which is in turn covered by a steel cover. An 18,000-hp. electric motor drives the 31-ft. diameter, 12-bladed propeller on an extension shaft from outside the tunnel shell.

Both tunnel and engine under test are controlled from an adjoining soundproof control room, where the operator governs the pressure, temperature, air speed within the tunnel, angle of attack of the model, and operation of the engine and propeller. Instruments indicate the forces on the model as well as complete performance data.

Low air pressures are maintained within the tunnel by means of four large Worthington reciprocating exhausters located in a nearby building and connected by large ducts to a streamlined scoop downstream of the model.

The ventilating air removed by the exhausters is replaced by air dried by Pittsburgh Lectrodryer dehumidifiers and refrigerated by York equipment. The main refrigeration of the wind tunnel is accomplished by means of a copperplate fin type of heat exchanger located in the 51-ft. diameter end of the wind tunnel and connected to fourteen Carrier refrigerating units installed in the refrigeration building.

Chief purpose of the tunnel is to save time in clearing for production new types of airplanes designed to operate at the highest attainable altitudes. The tunnel can be used to study performance at speeds and altitudes in excess of those attainable in test flights, and in addition permits control of air conditions manually. Any desired temperature and pressure combination may be obtained. Pittsburgh-Des Moines Steel Company, Pittsburgh.

Goggles With Interchangeable One-Piece Lenses

Men of the U.S. Army Air Forces are now being equipped with a new Polaroid goggle. It is reported to enable fliers to see upward, downward, and even out of the corners of their eyes because it is equipped with a one-piece 8-in. plastic lens extending from one side of the face to the other. The goggle frame and lens together protect eyes, cheeks, and forehead from frostbite and from burns caused by flash fires around fuel and oxygen lines in case of hits by incendiary bullets.

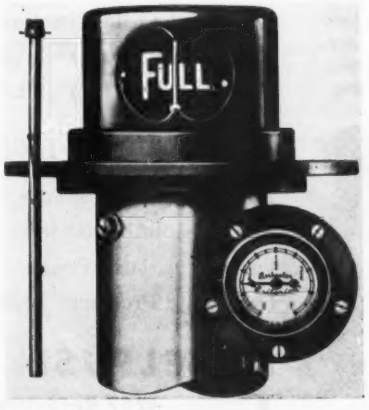
Officially designated A.A.F. Type B8, the new goggle has a flexible frame intended to fit all shapes and sizes of heads and faces. Each goggle comes in a kit that contains interchangeable green, amber, and crystal-clear plastic lenses. The clear lens provides wind protection; the green lens is for sunny days; the amber lens makes haze-covered targets easier to see. Polaroid Corporation, Cambridge, Mass.

Leakproof Level Gauge

A new leakproof liquid-level gauge is designed for use in bomb bay fuel tanks. It does not employ the conventional lever-type float that swings through an arc, but utilizes one that, with an attached Alnico permanent magnet, travels vertically within a tube. The tube has a spirally cut slot that guides the float and causes it to turn in accordance with the level of the fuel in the tank.

There is no mechanical connection between this part of the gauge head and the dial. The motion of the float is imparted to the dial indicator by magnetic action through the nonmagnetic metal floor that separates the dial chamber from the tank interior. This principle guards against leakage even if the dial head should be broken. No stuffing box or packing is used.

These gauges have large white fluorescent or phosphorescent markings that contrast with the dull black dial background; they may also be obtained with black figures on white background. Graduations are widely spaced because the dial swings through a 300° arc. The gauges are made with either side-view or top-view dials as desired. They can be mounted in metallic or rubber-cell tanks and are suited for applications where the float-and-lever type action might be impeded by the tank wall. Rochester Manufacturing Company, Rochester, N.Y.



The Rochester leakproof liquid-level gauge.

Engine-Driven Fuel Pump

A lightweight, high-pressure, engine-driven gasoline pump has been announced. Originally designed for aircraft, but adaptable to other applications for liquid handling, the new pump weighs only $2^3/_4$ lbs. and delivers 400 gal. per hour at 2,500 r.p.m. It also has a higher pressure range of from 6 to 35 lbs. per sq.in.

The pump is built with balanced-type relief valves and low-temperature shaft seals and is designed to withstand extreme temperature ranges. It was formerly known as U.S. Army type G-9, designed to meet specifications AN-P-52 and AN-P-56. Romec Pump Company, Elyria, O.

Improved Squeeze Riveter

The latest model Cincinnati pneumatic squeeze-type riveter is designed to drive tight rivets with uniform heads. With this machine the head is formed by compressing the rivet down to a given length. The cam, or wedge, travels past the highest point, giving action equivalent to that of a rotary cam traveling over center.

Depressing the valve causes the riveter to go through its cycle of operation. After the wedge passes its highest point the follower roller drops onto a relief that automatically releases pressure on the rivet. Thus the riveter can be moved toward its next riveting position as the valve is released. Only a light spring is required for the retraction of piston and wedge.

A cast aluminum piston with two automotive-type piston rings is intended to eliminate a cause of failure. The cam is full floating, being driven only on its rear face. Retraction is by a pin in a clearance hole. The manufacturer states that if wear should develop in either the cam, the cam-follower roller, or the back-up rollers, the cam will still maintain perfect alignment without any deflection of the piston. The valve seat is a Neoprene washer, quickly and cheaply replaceable. No packing is used. Schauer Machine Company, Cincinnati.

Snap-Gauge Spindle

Introduction of a new type of snap-gauge spindle for use with the Precision-aire instrument is stated to be the first application by any manufacturer combining the features of snap and airflow gauges.

An advantage claimed for this kind of spindle is that it can be used on highly finished or soft plated parts without marring or scratching them. It can also be used on thin-walled cylinders without any danger of collapsing them.

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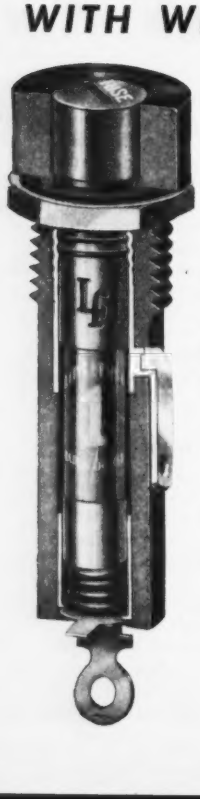

Extractor Post No. 341001 (Tool-operated type), for 3 AG Fuses. Welded side terminals. Knob and body black bakelite. Positive fuse grip. Full visual shock-proof inspection. Spring-activated cup. Specially designed grip prevents fuse from dropping out.

No. 342001 (Finger-operated type)

Resistance to extremes of shock, vibration and temperatures is provided by Littelfuse Extractor Posts with electrically welded side terminals. By Littelfuse process, terminals are made integral with inside metal shell. Maximum conductivity is insured. Other Littelfuse improvements for dependability, durability, and convenience make these extractor posts outstanding examples of Littelfuse *complete circuit protection.*

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The two other principal uses are for checking work while in the machine and for checking parts of large size or unwidely shape that could not be presented to the gauge. The manufacturer states that, by using the Precisionaire, a dimension can be checked to 0.0001 in. The Sheffield Corporation, Dayton, O.

Extended-Anvil Snap Gauges

Extended-anvil adjustable snap gauges are designed to facilitate the placing of work and alignment with the gauging anvils. The extended anvil provides a stable bearing when presenting the gauge to work in a machine. As a hand gauge the extended-anvil snap is reported to enable the inspection job to be done quickly, accurately, and with less fatigue. Used in a stand, this type of anvil provides a platform upon which the work piece is located in presenting it to gauging position.

Special locking devices are used on the adjustable anvils. Square-type anvils are furnished as standard, and pin-type anvils may be supplied on request. Twenty-five standard models cover the range 0.000 to 6.625 in. and also provide a choice of two lower anvils of different height. Larger sizes are available on special order. The Sheffield Corporation, Dayton, O.

Attitude Indicator

A new flight instrument is reported to be capable of providing the pilot with precise attitude indications throughout 360° of roll and pitch. By means of the Sperry Attitude Gyro Indicator, the pilot has a visual indication of the position of his aircraft with reference to the earth's surface throughout all possible attitudes through which his airplane can be maneuvered. The instrument is adaptable to all types of airplanes and is particularly valuable to those aircraft whose mission requires extensive and complicated aerobatics.

In the past, it has been impractical to perform all aerobatic maneuvers without visual reference to the earth's surface. Using the new instrument, however, it is now possible to accomplish such maneuvers with precision under instrument conditions. The pattern type of picturization of airplane motion that this instrument presents is so simple to interpret that during recent tests pilots were performing properly executed loops and slow rolls with less than an hour's instruction in its use.

As in other gyro flight instruments, a gyroscope is the major component of the new Attitude Gyro Indicator. Electrically propelled around a vertical axis, the gyro employs the familiar gyroscopic properties to provide a fixed reference pattern around which the plane may be maneuvered in any direction. This feature is made possible by a new method of suspension. The reference pattern is marked on the surface of a stabilized sphere with luminescent paint and is visible to the pilot through a masked opening in the front of the instrument case.

The indicating sphere is divided into hemispheres by painting the upper half

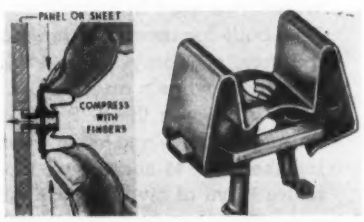
The Sheffield extended anvil adjustable snap gauge illustrated shows how easy it is to locate work with the extended anvil.

a luminiscent white and the lower half black. In order to increase the concept of a spherical surface, as well as to indicate pitch angle, latitude lines in contrasting color (white on black, black on white) are inscribed with short 10° marks between. A vertical meridian line, also in contrasting color, gives roll-angle indication with reference to a fixed index on the mask around the sphere. A lateral lubber line, marked in alternate black and white sections, stretches across the center of the mask opening and provide the basic pitch index for reference to the pattern of the sphere.

The only operating knob or adjustment required by the pilot is that for the "target," a small circle that adjusts up and down to compensate for change in trim of the airplane for level flight. Sperry Gyroscope Company, Inc.

Speed Nut for Instrument Mounting

Complying with the Army Air Forces Specification No. 25535, a new self-locking speed nut makes front mounting of aircraft instruments faster, easier, and more convenient. No changes in panel or instrument design, nor any special tools, are necessary to use this new fastener. No riveting, welding, or



The Tinnerman self-locking speed nut designed to simplify the front mounting of aircraft instruments.

spinning operations are required for installation. The operator merely compresses the cage and inserts the legs into the standard 0.171 in.-diameter clearance holes. The legs spring apart when pressure is released, the turned-up ends just clearing the back side of the panel. The nut will hold tight against the force of inserting the screw and the screw-tightening torque, and the floating speed nut within the cage allows for any misalignment of clearance holes.

Stock models are available with attaching legs of varying lengths to fit panel thicknesses from 0.062 in. to 0.375 in., and special designs can be made for panels exceeding 0.375 in. in thickness. The unit is made of nonmagnetic materials. The cage is of phosphor bronze, cadmium-plated, and the speed nut is of brass. The weight is less than 4 lbs. per 1,000 pieces. Tinnerman Products, Inc., Cleveland.

Glass-Fiber Synthetic-Coated Cloth

Great tensile strength at abnormally high temperatures, lightness in weight, and high tear resistance are the main features of a new flameproof glass-fiber synthetic rubber-coated cloth. In addition, this cloth resists the action of gasoline, oil, grease, water, mildew, and insects, and is not affected by acids or alkalis.

One important use is to protect personnel in airplanes at high altitudes through the elimination of possible breaks in metallic heating ducts caused by vibration and other contributing factors.

In fast combat planes that must operate at extreme altitudes, small openings have to be left between joints of metallic hot-air ducts to allow for vibration, expansion, and contraction. Sealing these openings tightly with a lightweight cloth strong enough to withstand the heat that passes through the hot-air ducts has been a problem that has now been solved by the development of the synthetic-coated flameproof glass cloth.

Double-coated, this same glass cloth is also being used for gun-bore aligning targets because it retains its shape without stretching or distortion of the gun-sighting pattern. The new-type targets act as a means for frequent checks of the gun-bore alignment with the gun sighting telescope. The weight of the finished double-coated glass cloth is only 7.6 oz. per sq.yd., and the single-coated cloth used for the metallic hot-air duct weighs only five oz. per sq.yd. The material is made in a variety of gauges from 0.006 to 0.040 and in tensile strengths from 165 to 800 lbs. per in. United States Rubber Company.

Vernier Caliper

A new precision caliper is designed to give a quick and accurate reading of an outside diameter, as measured between large jaws. It also affords a precision check on inside diameter by reading the same scale showing the spread of the minor inside jaws.

The caliper is used to measure the depth of a hole by inserting the depth-projection rod and reading the distance

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from the end of the rod to the body of the caliper on the same scale. The depth gauge is an integral part of the tool and not an attachment. Vard vernier calipers are made in one size only, with a spread of 6 in. between the jaws, and 7 in. of graduations on the face, thus making possible a full 6-in. reading.

The caliper is constructed of ground steel, its jaws being hardened and lapped. The calibrations are marked by the maker's own dividing machines, after which the numbers are engraved. One edge is divided in thirty-seconds, the other in fortieths, which read in thousandths in the vernier.

The vernier is integrally mounted on the slide and is locked in position or released by pressure on the thumb-lever. In addition to the vernier there is a witness point for reading the thirty-seconds scale. The vernier is adjustable to compensate for wear. Vard, Inc., Pasadena, Calif.

Spot-Welding Timer and Heat Control

Suitable for welding small objects of high conductivity, such as aluminum or copper, a new welding timer is announced. This welding timer possesses heat control for timing intervals of one-half cycle or less.

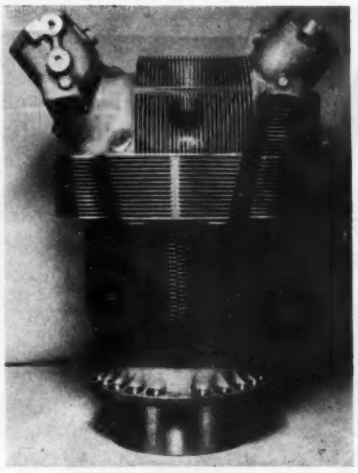
Precise, because the welding current is made to start at the same point on the voltage wave for every operation, the new SP-18, $^1/_2$-cycle timer is designed for welding of such items as radio tube parts and sockets, pigtail resistors to terminal lugs, instrument parts, contact tips on electrical relays, and other small parts.

The timer is furnished as a separate control for use with existing small bench welders and also in combination with a small welding transformer. Only one control tube is used, this thyratron serving the dual purpose of rectifying alternating current to charge a firing capacitor and also firing the small ignitron power tube. Heat control is accomplished by a phase-shift method regulated by means of an adjustment mounted on the cabinet door. Westinghouse Electric & Manufacturing Company.

Quick-Disconnect Couplings

Wiggins quick couplings developed for use on fuel, oil, instrument, and air lines in aircraft and other applications incorporate a "4-way" seal of synthetic rubber which can be used with either a standard "O" ring or square gasket. The coupling is out of the line of flow and is designed to operate with a pressure drop no greater than that in an equal length of tubing.

The maker states that the design eliminates all critical edges whose damage might impair the seal and that the life of the coupling exceeds that of threaded fittings. This new coupling is available for line sizes from $^1/_4$ to $1^1/_4$ in. for tubing or pipe, and from $^1/_4$ to 2 in. for hose connections. E. B. Wiggins Oil Tool Company, Inc., Los Angeles.



Attached to the steel barrel of this cylinder for a Cyclone engine manufactured by the Wright Aeronautical Corporation are 60 aluminum fins that give almost double the cooling area formerly provided by 40 steel fins cut from the barrel itself.

Magnetic Coupled Torquemeter

The magnetic coupled torquemeter is designed to afford a means of indicating the power output of an engine in flight, permitting the most economical adjustment of fuel consumption in order to increase the range of bombers and fighters. It conveys its information to the pilot by measuring the twist in the shaft connecting the engine to its propeller. The amount of twist is an accurate measure of the driving force delivered to the propeller by the engine.

The vital part of the torquemeter is a stationary metal sleeve and coil assembly that encircles the propeller shaft. Projecting from rings on the propeller shaft are two sets of teeth whose faces are a few thousandths of an inch apart. As the propeller shaft twists under load, the distance between these teeth changes. These changes are detected and reported electrically to a dial on the instrument mounted on the instrument panel of the plane. Operation of four torquemeters on a heavy bomber —one on each engine—will require only as much electric power as it takes to light an ordinary electric lamp. The four meters will add less than the weight of 10 gals. of gasoline to the plane's tonnage.

At present, bomber engines are adjusted for various flight altitudes and speeds by using a master engine chart and a formula, but this method may be ten to 15 per cent in error. The chart is based on a "standard" engine tested at the factory, but the performance of the engine in the plane may be very different because of the quality of gasoline and variations in operating conditions. This error in figuring horsepower may often result in improper adjustment of the engine controls so that the engine consumes more fuel than is actually required for the work it is doing. The torquemeter enables the pilot to estimate an engine's horsepower output within one or two per cent. With this knowledge he can adjust each engine's throttle, fuel-air ratio, and propeller pitch, so that all engines are delivering power at the same rate and at peak economy.

Other magnetic torquemeters are destined for use in laboratories where new types of aircraft, truck, and tank engines are being developed, and in Naval laboratories, where engineers need accurate measurements of the power transmitted by a ship's propeller shaft, a set of reduction gears, or a steam turbine. Westinghouse Electric & Manufacturing Company.

"W" Fin Process for Joining Aluminum Fins to Steel Cylinder Barrels

A new engineering design that will permit greater horsepower output of air-cooled aircraft engines and also save 24,000,000 lbs. of alloy steel per year has been developed by Wright Aeronautical Corporation, in cooperation with the Scandia Manufacturing Company. The new design makes possible the use of aluminum cooling fins on steel cylinder barrels, with the steel-aluminum combination giving almost twice the cooling area of the all-steel fins. Sixty fins can be mounted on a barrel in the same space formerly required for 40 steel fins machined from the barrel wall. The increased cooling area, coupled with the fact that aluminum can dissipate heat more rapidly than steel, results in cooler operation and permits more power to be taken from the engine.

The new fin, known as the "W" fin, eliminates the machining operation by which the fins were cut into the steel barrel. The "W" fin is produced by folding a strip of sheet aluminum into the form of an exaggerated letter "W," with the two outside legs 1 in. high and the center portion only $^1/_8$ in. in height. These strips are cut to size, shaped into half-circles, and then snapped into shallow dovetail grooves cut into the barrel. A special tool then rolls over the short center section of the "W," flattening this section and wedging the outside legs of the "W" into the dovetail grooves. This wedging not only holds the fin firmly in place but also provides a broad contact area through which heat can pass from the steel wall of the barrel into the aluminum fin. The aluminum fins can be made to almost any desired height, whereas the steel fins had virtually reached the maximum depth to which they could be cut in quantity production.

While this new barrel does not materially affect the overall weight of the engine, the saving being only 1 lb. per cylinder, there is a very important saving in the quantity of raw material required, the rough forging for the new barrel being substantially lighter than that for the older model. In one year's production of Cyclones, this saving will amount to 24,000,000 lbs. Wright Aeronautical Corporation.

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HELPING TO WRITE THE STORY OF TOMORROW

Institute News

Second Group Visit to Patterson and Wright Fields

A second organized tour and inspection of the facilities and operations of the Air Service Command and the Matériel Command was made by a group of 74 Institute members on August 4 and 5. Lt. Gen. William S. Knudsen, Director of the Army Air Forces Matériel and Services Command, gave a brief address of welcome at Patterson Field.

After the first day's tour of Patterson Field, members and officers from Wright and Patterson Fields dined at the Patterson Field Officers' Club. Following the dinner meeting, the members heard talks by Major Gen. B. E. Meyers, Deputy Director of the A.A.F.M. and S.; Major Gen. Clements McMullen, Chief of the A.S.C. Maintenance Division; Lester D. Gardner; Dr. G. W. Lewis; and the Hon. Oswald Ryan. Dr. J. C. Hunsaker, Mr. T. P. Wright, and Dr. Hugh L. Dryden also spoke.

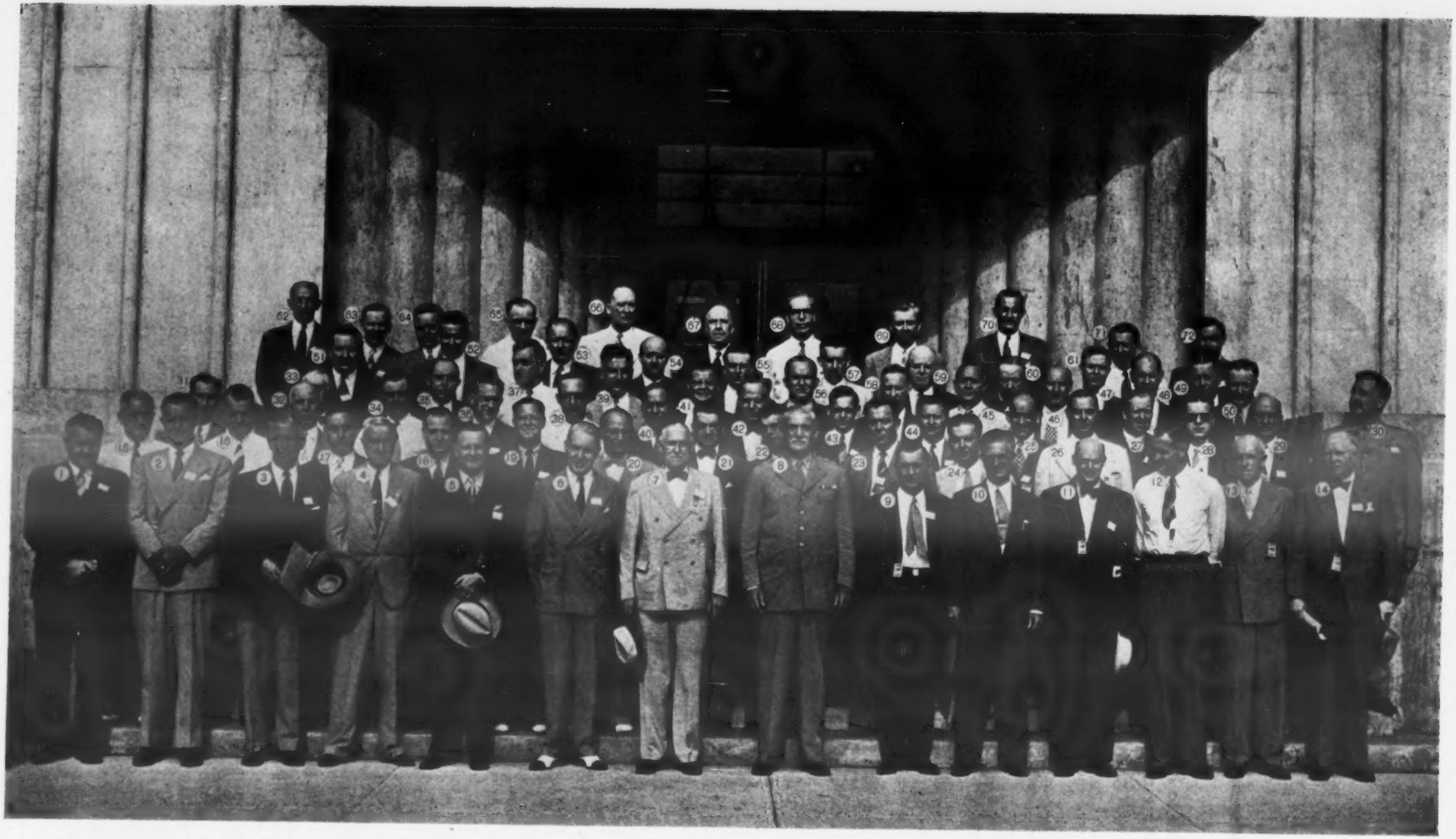
A telegram was read from Gen. H. H. Arnold, who said: "Please extend my hearty welcome to the Institute Members visiting Wright Field, August four and five. The advantages of these meetings between engineering groups and the Army Air Forces cannot be stressed too highly. Such close cooperation has greatly benefited the prosecution of the war."

Brig. Gen. Patrick W. Timberlake, Deputy Chief of Air Staff of the Army Air Forces, wrote in part as follows: "I have examined with interest the names of the men whom you have selected and agree with you that a better understanding between the Army Air Forces and Industry results from such visits. We of the Army Air Forces are keenly aware of the outstanding contribution that industry and its leaders have made towards the accomplishment of our responsibility. We hope never to overlook any opportunity to bring about an even closer cooperation between engineering groups and ourselves now, and in the postwar period. Accordingly, I wish to compliment you on your program and trust that your group will enjoy its visit as much as we welcome the opportunity of acting as your host."

On August 5, the group visited Wright Field. Brig. Gen. F. O. Carroll, Chief of the Engineering Division, addressed the group, after which the party was divided into three sections for a tour of the Field.

The complete list of those who made the visit follows: Robert M. Adamson, Manager, Aviation Department, Shell Oil Company Inc.; B. N. Ashton, Vice-President, Electrol Incorporated; L. A. Baldwin, Vice-President, Johns-Manville Sales Corporation; Daniel P. Barnard, IV, Associate Director of Research, Standard Oil Company (Indiana); Lawrence D. Bell, President, Bell Aircraft Corporation; Howard A. Benzel, Vice-President and Chief Engineer, Scott Aviation Corporation; Harry E. Blythe, Vice-President and General Manager, Goodyear Aircraft Corporation; Paul H. Brattain, First Vice-President, Eastern Air Lines, Inc.; Ernest R. Breech, President, Bendix Aviation Corporation; Clayton J. Brukner, President, The Waco Aircraft Company; George W. Burgess, Assistant to W. A. M. Burden, Assistant Secretary of Commerce; Forest S. Burtch, Manager of Sales, Aircord Division, John A. Roebling's Sons Company; Harold H. Buttner, Vice-President, Federal Telephone & Radio Corporation; G. T. Christopher, President and General Manager, Packard Motor Car Company; Heyliger Church, Sales Manager, Airplane Division, The Weatherhead Company; Charles F. Codrington, Engineer, Allis-Chalmers Manufacturing Company; R. A. Dadisman, Manager, Market Development Division, The American Rolling Mill Company; C. W. Deeds, President, Niles-Bement-Pond Company & Chandler-Evans Corporation; Robert R. Dexter, Secretary, Institute of the Aeronautical Sciences; John P. Dods, Director of Sales Research, Summerill Tubing Company; Hugh L. Dryden, Chief of Mechanics & Sound Division, National Bureau of Standards; James M. Eaton, Vice-President, American Export Airlines, Inc.; Allan D. Emil, Director, Square D Company; Herbert G. Fales, Vice-President, The International Nickel Company, Inc.; J. A. Faucher, Assistant to Director of War Products Division, United States Rubber Company; N. M. Forsythe, Vice-President, Pesco Products Company Division, Borg-Warner Corporation; John W. Friedlander, President, Aeronca Aircraft Corporation; Lester D. Gardner, President, Aeronautical Archives, Institute of the Aeronautical Sciences; R. E. Gillmor, President, Sperry Gyroscope Company, Inc.; Leroy R. Grumman, President, Grumman Aircraft Engineering Corporation; Allen Guiberson, Executive Vice-President, Guiberson Diesel Engine Company; Andrew G. Haley, President, Aerojet Engineering Corporation; James C. Hart, President, Taylorcraft Aviation Corporation; Raymond Haskell, Consulting Engineer, The Texas Company; Edwin C. Hetherwick, Vice-President and

Officers of the Los Angeles Section. This photograph was taken before the start of the Summer Annual Meeting at the University of Southern California. Left to right are Philip Colman of the Lockheed Aircraft Corporation, Chairman of Program Committee; Arthur E. Raymond, Vice-President and Chief Engineer of Douglas Aircraft Company, Inc., Chairman; J. Richard Goldstein, Douglas Aircraft Company, Inc., Cochairman of the Thursday afternoon session; E. J. Horkey, North American Aviation, Inc., Secretary.



A photograph of members of the Institute and officers from Patterson Field, taken before the tour of Patterson Field on August 4. (1) B. R. Otto, (2) Fred H. Rohr, (3) Frank A. Howard, (4) A. C. Streamer, (5) Hon. Josh Lee, (6) Hon. Oswald Ryan, (7) Lester D. Gardner, (8) Lt. Gen. William S. Knudsen, (9) Hugh L. Dryden, (10) T. P. Wright, (11) J. C. Hunsaker, (12) Harry E. Blythe, (13) Arthur L. Parker, (14) George W. Lewis, (15) John P. Dods, (16) Arthur T. Newell, (17) Richard M. Mock, (18) R. A. Dadisman, (19) N. M. Forsythe, (20) Don J. Phelps, (21) Robert W. Stoddard, (22) William P. Lear, (23) Allen Guiberson, (24) Charles W. Meyers, (25) Harold H. Buttner, (26) R. G. Kellett, (27) Leroy R. Grumman, (28) Charles H. Miller, (29) James S. Ogsbury, (30) Lt. Col. Henry M. Paynter, (31) Robert M. Adamson, (32) Roy C. Muir, (33) Francis W. Magin, (34) P. E. Lakin, (35) J. J. Hilt, (36) R. E. Gillmor, (37) Otto T. Kreusser, (38) C. W. Deeds, (39) John C. Mathes, (40) James M. Eaton, (41) Elmer A. Sperry, Jr., (42) George W. Burgess, (43) Howard A. Benzel, (44) Wilbur Shaw, (45) Heyliger Church, (46) Charles S. Jones, (47) Charles F. Codrington, (48) John W. Friedlander, (49) Paul H. Brattain, (50) Clayton J. Brukner, (51) W. A. Hite, (52) Herbert G. Fales, (53) L. A. Baldwin, (54) Edwin C. Hetherwick, (55) Robert R. Dexter, (56) Tom Salter, (57) J. A. Faucher, (58) Forest S. Burtch, (59) George P. Torrence, (60) Russell F. Rogers, (61) Charles F. Codrington, (62) Allan D. Emil, (63) B. N. Ashton, (64) Ernest R. Breech, (65) G. T. Christopher, (66) Harry S. Rogers, (67) Raymond Haskell, (68) H. J. E. Reid, (69) Daniel P. Barnard, IV, (70) Joseph J. Maitan, (71) Andrew G. Haley, (72) Armand J. Thieblot.

General Manager, Hayes Industries, Inc.; W. A. Hite, Vice-President, Interstate Aircraft & Engineering Corporation; J. J. Hilt, Vice-President, Young Radiator Company; Frank A. Howard, Vice-President, Standard Oil Company of New Jersey; J. C. Hunsaker, Chairman, National Advisory Committee for Aeronautics; Charles S. Jones, President, Casey Jones School of Aeronautics; R. G. Kellett, Executive Vice-President, Kellett Aircraft Corporation; Otto T. Kreusser, Director of Service & Training, Allison Division, General Motors Corporation; P. E. Lakin, Vice-President, Shell Oil Company, Inc.; William P. Lear, President and Chief Designer, Lear, Inc.; Hon. Josh Lee, Member, Civil Aeronautics Board; George W. Lewis, Director of Aeronautical Research, National Advisory Committee for Aeronautics; Francis W. Magin, President, Square D Company; Joseph J. Maitan, Controller, Institute of the Aeronautical Sciences; John C. Mathes, Development Engineer, Magnesium Division, The Dow Chemical Company; Charles W. Meyers, Special Representative—Aviation, American Steel & Wire Company; Charles H. Miller, Vice-President, Republic Aviation Corporation; Richard M. Mock, Vice-President in Charge of Engineering, Lear, Inc.; Roy C. Muir, Vice-President, General Electric Company; Arthur T. Newell, President and Chief Engineer, Kenyon Instrument Company, Inc.; James S. Ogsbury, President, Fairchild Camera & Instrument Corporation; B. R. Otto, President, Otto Aviation Corporation; Arthur L. Parker, President, The Parker Appliance Company; Don J. Phelps, Vice-President, General Instrument Corporation; H. J. E. Reid, Engineer in Charge, Langley Memorial Aeronautical Laboratory, National Advisory Committee for Aeronautics; Harry S. Rogers, President, Polytechnic Institute of Brooklyn; Russell F. Rogers, Manager, AERONAUTICAL ENGINEERING REVIEW; Fred H. Rohr, President and General Manager, Rohr Aircraft Corporation; Hon. Oswald Ryan, Member, Civil Aeronautics Board; Tom Salter, Chief Engineer, Cessna Aircraft Company; John A. Sanborn, General Manager, Manufacturers Aircraft Association; Wilbur Shaw, Director Sales and Engineering, Firestone Aircraft Company; Elmer A. Sperry, Jr., Vice-President, Sperry Products, Inc.; Robert W. Stoddard, Vice-President, Wyman-Gordon Company; William B. Stout, Director of Research, Stout Research Division, Consolidated Vultee Aircraft Corporation; A. C. Streamer, Vice-President, Westinghouse Electric & Manufacturing Company; Armand J. Thieblot, Chief Engineer, Fairchild Aircraft Division, Fairchild Engine & Airplane Corporation; George P. Torrence, President, The Cleveland Pneumatic Tool Company; T. P. Wright, Director, Aircraft Resources Control Office, Aircraft Production Board; Vincent C. Young, Chief Engineer, Wilcox-Rich Division, Eaton Manufacturing Company.

Gifts to the Aeronautical Archives

W. A. M. Burden gave 428 issues of aeronautical magazines. Five thousand mounted and indexed clippings for the year 1936 were given by the National Aviation Corporation. Miss Dorothy Monro gave 31 aeronautical magazines and 44 clippings. A new map for measuring true air distances and directions from New York City was received from John W. Wood. Ten textbooks were received from the National Defense Publications Bureau of the New York State Department of Education. The Civil Aeronautics Board gave schedule frequency maps of Canada and Mexico.

Geoffrey Smith sent a copy of *Achievements in British Aircraft*. The British Air Commission in Washington added 26 *British Air Ministry Translations* to the large collection it had previously given. Dr. Alexander Klemin added clippings and pamphlets to his previous gifts. The Surplus War Property Administration sent two copies of its *Report on Surplus Aircraft Disposal*. The Operating Committee on Aircraft Materials Conservation of the Aircraft Resources Control Office gave copies of its conservation directives and bulletins.

A Pratt and Whitney silver match case was received from Harold L. Hartman. Four colored prints of the P-47 Thunderbolt fighter airplane were sent by the Republic Aviation Corporation through the courtesy of Alfred Marchev. The Glenn L. Martin Company gave a Marauder cigar stand. Mrs. Barton K. Yount gave aeronautical Christmas cards and four copies of *Air Forces Airs*. A hammer used in the Douglas Aircraft Company factory in Santa Monica in making the wings of the first around-the-world cruisers was given by Robert W. Hambrook. Mrs. Bella C. Landauer added a Franklin D. Roosevelt plate and a table cover to her previous gifts.

Major Donald D. Millikan gave five telautograph and photographic recordings made from airplane to ground between 1912 and 1938, and four books. A cloth insigne of the Fleet Air Arm of the British Royal Navy was received from Lt. J. P. M. Reid. The American Helicopter Society, Inc., sent its pin and its first printed bulletin—a lecture by Dr. J. A. J. Bennett on the development of rotary aircraft.

Cuban Army Air Corps insignia and a mounted and labeled set of Mexican Air Force insignia were presented through Headquarters of the Army Air Forces and Brig. Gen. Robert W. Harper. Identification badges and insignia were received from the American Aircraft Manufacturing Company, American Export Airlines, Inc., KLM Royal Dutch Airlines, Pioneer Parachute Company, and Sperry Gyroscope Company, Inc.

Additional gifts were received from the Bureau of Foreign and Domestic Commerce, Civil Aeronautics Administration, House Document Room, and the Women's Bureau of the Department of Labor.

1944 Branch Award Winners

Each year the Institute awards to each of two students in each Student Branch a certificate and an honorarium providing for a 2-year prepaid membership in the Institute. These awards are given for outstanding scholastic work in aeronautical engineering and for preparing and presenting the best lecture at a regular meeting of the Student Branch.

The certificate carries the name of the winner, the year, and the name of the Student Branch and is signed by the President of the Institute and the honorary chairman of the Student Branch.

The following Student Branches have reported their award winners for 1944 as follows:

Student Branch Scholastic Awards—Aeronautical University, George G. Graham; University of Alabama, Joseph A. Ready; Polytechnic Institute of Brooklyn, Lucien G. Virgile; California Institute of Technology, Dean Chapman; Case School of Applied Science, James D. Ryan; Casey Jones School of Aeronautics, Murray Bernard; University of Detroit, John P. Wamser; Georgia School of Technology, Paul E. Steele; Iowa State University, Paul W. Burke; Louisiana State University, Richard Hoskins; New York University, Thomas T. Scambos; Pittsburgh University, Harry E. Bloomer; Purdue University, Robert E. Gwinn and John E. Loufek; Spartan College of Aeronautical Engineering, Archie T. Chapel and Carl Victor Lindow; University of Texas, Harold J. McNeel; Tri-State College, Donald W. Burton.

Student Branch Lecture Awards—Aeronautical University, Gilbert W. Heller; Polytechnic Institute of Brooklyn, Jack Heller; Case School of Applied Science, Robert F. Robinson; Casey Jones School of Aeronautics, Louis B. Rodriguez; University of Detroit, George M. Galster; Georgia School of Technology, George P. Bates; Indiana Technical College, Ralph P. Wilcox; Louisiana State University, Charles E. Neyland; New York University, William Wait, 3rd; University of Minnesota, Alexander Sowyrda; Purdue University, Don Gault; University of Texas, Harold J. McNeel.

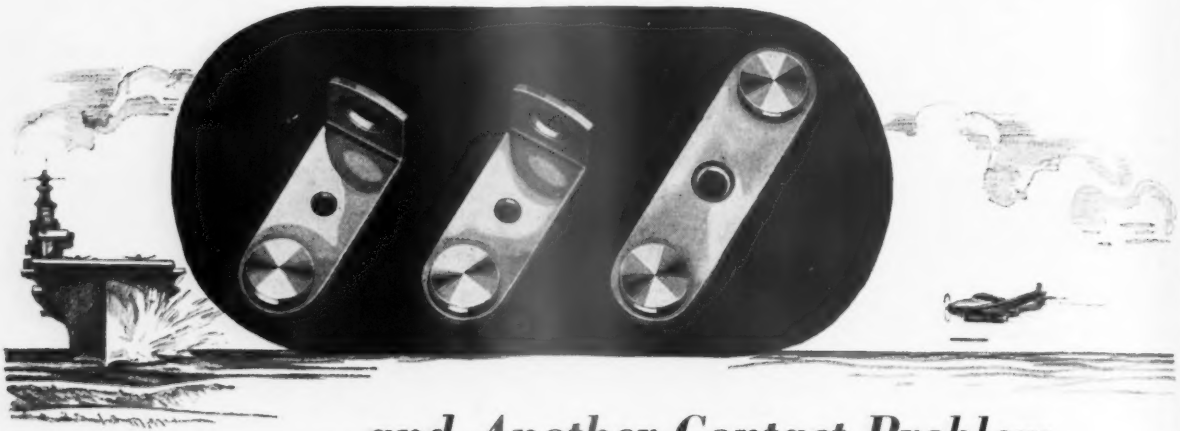
New Corporate Members

The following are brief summaries of the products and activities of companies that have recently become Corporate Members of the Institute.

Langley Corporation, San Diego, Calif., began in the latter part of 1939 to apply part of its precision machining facilities to the fabrication of gear boxes and mechanisms for the Catalina flying boat. The corporation's facilities were soon fully employed in that work and in other work of a more complex nature.

Among a total of approximately 30 different types of assemblies, the corporation has produced a special type of control column for pilots and copilots; aileron-control mechanisms; gear boxes for tab operation (at the pilot's position

Another "Flat-Top" Scratched



...and Another Contact Problem solved by Mallory Engineering

It takes skill and nerve to sink an enemy vessel. But it also takes a good electrical relay—with the best contacts it is possible to make. Without such a relay, equipped with such contacts, deadly torpedoes could never be launched.

Consider these specifications, recently entrusted to Mallory engineers—specifications for a new type of torpedo bomber relay contact: Contacts to carry 25 amperes current of 29 volts DC, and to "make and break contact" once every second for 10,000 operations . . . the same contacts to carry an overload of 50 amperes at 24 volts DC for 100 operations, and to show no more than a 0.10 drop in voltage with 25 amperes.

The design prevented brazing the contact into the assembly. To avoid this factor, Mallory engineers developed a new powdered metal. This metal, Mallory D-52, met the electrical requirements and was sufficiently ductile to be made as solid rivets that could be easily staked or spun into the assembly.

Mallory solved this problem as it has many others, and the knowledge thus gained is still another additive of experience that's ready to be passed along to you. No one in the contact business has more all around "know how," or a more brilliant record for putting it to good use, than Mallory engineers. Why not put Mallory to work for *you?* Just send a drawing or description of the application you have in mind.

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as well as in the surfaces); recoil mechanisms and operational devices for the control of the retracting floats; flap-lowering gear boxes; right-angle and high-speed drives; landing-gear emergency lowering mechanism; and others. Important structural parts have been fabricated in large quantities. Development and research work have been carried out on all products.

The Langley products have been incorporated in the flight controls of several of the largest airplanes used by the armed forces. The corporation looks forward to the application of its specialized work to the development of the airplane and kindred work as applicable to helicopter and autogiro drives or other functional equipment requiring light weight as one of the major considerations.

Young Radiator Company, Racine, Wis., has been designing and manufacturing heat-transfer products since the early part of 1927. The principals of the company, however, have been identified with the heat-transfer business for a greater length of time. An introduction to the aircraft field was accorded when F. M. Young, president of the organization, was called on to build a coolant radiator for the airplane used by Glenn L. Martin in his "Round the Great Lakes" flight in 1913. The first aircraft heat-transfer units produced by the Young Radiator Company were oil coolers built for the U.S. Army Air Corps in 1932. From that time on, aircraft has played an important part in the company's development and production program.

With the advent of World War II and increased demands for all types of equipment for military aircraft, the company expanded its facilities to correspond to the increased requirements. At present, it supplies oil coolers; coolant radiators; temperature and surge-protection valves, both cooler and line type; supercharger intercoolers, and cabin-heating coils. Although space and weight limitations on all aircraft products are held to a minimum (resulting in differences of construction), the fundamentals of heat-transfer and control are identical, and the experience gained in all fields has been incorporated with modern aircraft techniques into the design of units the company is now making for military and essential civilian aircraft requirements.

Sections and Branches

Los Angeles Section

A dinner meeting of the Los Angeles Section was held on June 15, at which plans were discussed for obtaining a building site for a headquarters for the section. Mr. Ray Kelley, architect, offered a tentative outline of the plans for the building. One hundred and sixty-five members attended the meeting.

The speaker of the evening was W. W. Beman of the Lockheed Aircraft Corporation, who spoke on "Airplane Ma-

I. A. S.

National Meetings Schedule

1944–1945

October 20, 1944
AIR TRANSPORT MEETING — WASHINGTON, D.C.

November 9–10, 1944
FALL MEETING — DAYTON, OHIO

December 17, 1944
WRIGHT BROTHERS LECTURE — WASHINGTON, D.C.

January 30–31, February 1, 1945
THIRTEENTH ANNUAL MEETING — NEW YORK

April, 1945
SPRING MEETING — DETROIT, MICHIGAN

The Officers and Council of the Institute invite participation in the Technical Sessions of the Meetings of the Institute.

The Meetings Committee will consider for inclusion on the program complete papers, or outlines or summaries of proposed papers.

Information for Participants

(1) Complete papers, or outlines or summaries should be submitted in triplicate at least four months prior to the meeting at which it is proposed to present the paper. Outlines or summaries should not exceed 1,000 words.

(2) Each paper should be so planned that it may be presented within a time limit of 45 minutes.

(3) All papers submitted will be considered for publication in the **Journal of the Aeronautical Sciences** or the **Aeronautical Engineering Review.** While a paper should be planned to take only 45 minutes for presentation at a meeting, the written presentation may have a maximum length of approximately 15,000 words.

(4) All material received will be submitted to the Meetings Committee. Authors will be notified, in ample time to prepare the complete paper, whether or not their papers can be scheduled for presentation.

All correspondence should be addressed to
The Meetings Committee
Institute of the Aeronautical Sciences
1505 RCA Building West
30 Rockefeller Plaza
New York 20, N. Y.

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CARBURETORS AND ACCESSORIES

neuvers and Related Tail Loads." Prepared discussions of the paper were given by H. A. Storms, Jr., of North American Aviation, Inc., and C. H. Stevenson, Douglas Aircraft Company, Inc., El Segundo Plant. General discussions from the floor were also given.

Officers of the Los Angeles Section are as follows: Chairman, A. E. Raymond; Vice-Chairman, C. L. Johnson; Secretary, E. J. Horkey; Treasurer, W. Cerny.

Niagara Frontier Section

The first technical meeting of the 1944–1945 year of the Niagara Frontier Section was held at the Hotel Westbrook on July 25. Seventy-eight members attended the meeting.

A business meeting was held at which the membership of numerous committees was announced, and a report for each committee was given by the respective chairman. The treasurer's report gave details of the financial condition of the Section. It was decided that future meetings would take the form of dinner meetings and that one meeting per month would be held.

Dr. Cartledge of the Curtiss Research Laboratory was introduced and gave a lecture on "Vapor Lock in Aircraft Fuel Systems." The lecture was supplemented by slides and motion pictures showing the experimental investigations conducted at the Research Laboratory in conjunction with actual flight-test investigations.

George Ray of Bell Aircraft Corporation gave an account of the trends in the development of Russian fighter aircraft types. In the course of his lecture he compared the designs of American fighter planes with the Russian, indicating the points of similarity and the differences in the various types. He summarized his talk by enumerating the latest tendencies affecting the design of Russian fighter aircraft.

Discussions followed each lecture.

Philadelphia Section

A combined dinner and business meeting of the Philadelphia Section was held on June 21 at the Engineers Club of Philadelphia. The following officers were elected: Chairman, Harry S. Egerton; Vice-Chairman, Capt. Ralph Barnaby, U.S.N.; Secretary, Ralph McClarren; Treasurer, William H. Womer.

Executive committee members were elected as follows: Richard H. Prewitt, Frank Tatnall, Norman Jump, Haskell Gordon.

Following the election of officers, motion pictures were shown of the Kellett Direct-Control Autogiro.

Rensselaer Polytechnic Institute

A meeting of the Rensselaer Polytechnic Institute Student Branch was held on May 12 with an attendance of 250 members and guests.

Dr. Paul E. Hemke, Head of the Department of Aeronautical Engineering, introduced the speaker of the evening, Mr. Benson Hamlin, a graduate of Rensselaer Polytechnic Institute in 1937. Mr. Hamlin, Senior Flight Research Engineer at Bell Aircraft Corporation, spoke on jet propulsion. His talk gave as complete a coverage of the subject as wartime regulations would permit. Following the lecture the speaker showed color motion pictures of the new Bell helicopter.

News of Members

Capt. Ralph Stanton Barnaby, U.S. Navy, who has been Chief Engineer of the Naval Aircraft Factory at Philadelphia for the past year, has been made Commanding Officer of the Naval Aircraft Modification Unit, Naval Air Material Center at Johnsville, Pa.

Charles H. Gale has established the firm of Charles H. Gale and Associates in New York, engaged in public relations counsel and research and editorial services.

Ernest F. Gamache is now General Administrative Manager and Acting Sales Manager at Simmonds Aerocessories, Inc.

Haskell R. Gordon was appointed Aeronautical Engineer at the Naval Air Experimental Station in Philadelphia.

William V. Holden has joined the Engine Room branch of the Canadian Navy.

Norman Jump is now supervisor of Tool and Operation Planning at Consolidated Vultee Aircraft Corporation.

George Kass has become Project Engineer in the Research Laboratories of Sperry Gyroscope Company, Inc.

Lester G. Kelso has been advanced from instructor to Assistant Professor at Iowa State College Department of Aeronautical Engineering.

Frederick W. Mesinger, formerly District Manager of the New York office of Norma-Hoffman Bearings Corporation, was elected Vice-President of the corporation.

Edwin H. Olmstead has joined Jack and Heintz, Inc., as Project Engineer.

Leonard C. Peskin was named Director of the Contracts Division at Kellett Aircraft Corporation.

Marvin Redfield has been commissioned an Ensign in the U.S. Naval Reserve.

Henry S. Stillwell has been appointed Head of the new Aeronautical Engineering Department at the University of Illinois.

Francis G. Tatnall has become Manager of the Testing Machine Department at the Baldwin-Southwark Division of The Baldwin Locomotive Works.

William H. Womer was appointed Assistant Aeronautical Engineer at the Naval Aircraft Factory in Philadelphia.

Members Elected

The following applicants for membership or applicants for change of previous grade have been admitted to membership in the grades indicated since the publication of the list in the last issue of the REVIEW.

Transferred to Associate Fellow Grade

Burnstan, Rowland, President, Lawrance Aeronautical Corp.

Mautner, Steven Etienne, Vice-President-Chief Engineer, Skydyne Inc.

Elected to MEMBER Grade

Cornell, Sidney, B.S. in M.E.; Engineer, Pratt & Whitney Aircraft Div., United Aircraft Corp.

Foster, Leo Joseph, Jr., C.E.; Lt. Col., U.S. Army Air Forces.

Gigante, Joseph William, B. in Ae.E.; Structures Engineer, Stinson Div., Consolidated Vultee Aircraft Corp.

Greg, Wesvolode A., M.A. in Ae.E.; Project Engineer, Airex Mfg. Co., Inc.

Hayward, Robert, Production Engineer, U.S. Army Air Forces.

Isserstedt, Siegfried Gordon, Executive Engineer, Canadian Aircraft Instrument & Accessories Ltd.

Lederer, Ludwig George, Ph.D.; Medical Director, Pennsylvania Central Airlines.

Ostlund, Evert Manuel, B. of E.E.; Sr. Engineer, Federal Telephone & Radio Corp.

Oviatt, S. Allen, B.S. in M.E.; Capt., Asst. Technical Executive, Matériel Command Headquarters, U.S. Army Air Forces.

Recipu'i, Bruno Carl, B.S., in Engineering; Engineering Service Representative, Adel Precision Products Corp.

Rugo, Albert C., B.S.; Associate Aero. Engineer, Naval Air Experimental Station.

Sabara, Walter Eryk, B.S. in Ae.E.; Stress Analyst, Engineering Div., Douglas Aircraft Co., Inc.

Smith, Philip, B.Sc.; Group Leader, de Havilland Aircraft Corp.

Woodhead, Harry, President, Consolidated Vultee Aircraft Corp.

Wooler, Ernest, Chief Engineer, Bower Roller Bearing Co.

Zelinski, Bruno Clarence, B.S. in C.E.; Design Engineer, Consolidated Vultee Aircraft Corp.

Transferred to MEMBER Grade

Rosenbaum, Mortimer, B.S. in Ae.E.; Structures Group Engineer, Development Engineering Dept., Consolidated Vultee Aircraft Corp.

Elected to Industrial Member Grade

Cameron, William, Statistician, The de Havilland Aircraft of Canada Ltd.

Torrence, George Paull, B.S. in M.E.; President and General Manager, Cleveland Pneumatic Tool Co.

Elected to Technical Member Grade

Carroll, Thomas Francis, Jr., Contact Engineer, Fisher Cleveland Aircraft Plant No. 2.

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Coates, Edmund William, Technical Assistant, Blackburn Aircraft, Ltd.

Deptula, Alfred Robert, B. of Struct. Eng.; 2nd Lt., U.S. Army Air Forces.

Eshelman, Ralph Hershel, Loftsman, Goodyear Aircraft Corp.

Horton, Emmett Joseph, B.Ae.E.; Engineer, Ford Motor Co.

Kravitz, David, Draftsman, Bell Aircraft Corp.

Petersen, Clifford, B. of Sc. in C.E.; Research Engineer, Aerotor.

Pieper, Paul Anthony, Engineer, Curtiss-Wright Corp.

Robinson, Richard Samuels, Technical Writer, Consolidated Vultee Aircraft Corp.

Schreiber, Robert Elwood, M.E.; Lt., Flight Test Engineer, Flight Section, U.S. Army Air Forces.

Transferred from Student to Technical Member

Cooney, Thomas V., B.S.A.E.

Galster, George M., *Branch Award Winner,* B.S.A.E.

Gwinn, Robert E., *Branch Award Winner,* B.S.A.E.

Johnsen, Howard H., B.S.A.E.

Juul, Taga, B.S.A.E.

Kearns, John P., Jr., B.S.A.E.

Lindow, Carl V., *Branch Award Winner,* Associate in Aero. Engineering.

Mayer, John P., B.S.A.E.

Olson, Oscar L., Jr., B.S.A.E.

Pliske, Daniel R., B.S.A.E.

Sherman, Patrick A., B.S.M.E.

Vlastnik, Lawrence J., B.S.A.E.

Wood, Herbert, Jr., B.S.M.E.

Elected to Affiliate Grade

Caplin, Victor, B.A.; Statistician, Air Transport Association of America.

Centye, Julian Joseph, Engineering Instructor, U.S. Army Air Forces.

Coleman, Richard Emmet, Sr. Layout Man, Republic Aviation Corp.

Hayward, John Francis, Draughtsman (Jr. Engineering), The de Havilland Aircraft of Canada Ltd.

Personnel Opportunities

This column is for the use of individual members of the Institute seeking new connections and organizations offering employment to aeronautical specialists. Any member or organization may have requirements listed without charge by writing to the Secretary of the Institute.

WANTED

Graduate Junior and Senior Mechanical and Civil Engineers—Excellent immediate and postwar opportunity for qualified engineers who have specialized in Stress Analysis. Must comply with W.M.C. regulations. Apply by letter only to: Lear, Inc., Piqua, Ohio, R. J. Biggs, Special Representative.

Stress Analysts—at least two years' experience on aircraft stress analysis for similar work on plastic aircraft assemblies involving nonwrinkling skin construction. Address inquiries giving education, experience in detail, draft status and salary requirements to Universal Moulded Products Corporation, Bristol, Va., Attention Dr. R. J. Nebesar.

Aircraft Engineers—Openings available in progressive Aircraft Company for layout and design engineers to cover Wing, Empennage, Power Plant, Fuselage, Electrical and Radio, Landing Gear, Hydraulics, Equipment, and Controls. Also openings for Tool Designers, Tool Planners, Production Planners, Loftsmen and Aircraft Drawing, and Template Checkers. Those presently employed in essential war work need not apply. Airmail complete detailed information regarding education, experience, salaries, former employers, age, family status, citizenship, and draft status, in order that we may be able to evaluate your qualifications from the first letter. Address inquiries Higgins Aircraft, Inc., P.O. Box 32, New Orleans 6, La.

Graduate Engineers for essential war work, opportunity for advancement and increased earnings. Aeronautical experience not necessary. Must be citizen, not employed in essential war industry, or have certificate of availability from the U.S. Employment Service Office or War Manpower Commission of your area. Write direct, stating school, age, degree, experience, draft classification, and marital status to Consolidated Vultee Aircraft Corporation, Industrial Training Division, San Diego, Calif.

Aeronautical Engineer wanted for promotional work in expanding line of highly specialized equipment for aircraft, also airway and airport control tower equipment. Must have extensive background in aircraft instrumentation, know the pilot's problems and the requirements of the air lines. Good basic knowledge in aerodynamics, physics, and electronics necessary. Engineering sales and service experience contacting air lines and aircraft manufacturers desirable. Apply Wallace & Tiernan Products, Inc., Belleville 9, N.J.

Engineers—Design, aeronautical experience necessary; particular reference to work in hydraulics and structural design; also engineering draftsmen with aeronautical background. Address inquiries to Box 228, Institute of the Aeronautical Sciences.

(*Continued on page 193*)

Necrology

Lt. Col. John Howard Yeomans

Lt. Col. John Howard Yeomans was killed in an airplane accident near Khartoum, Egypt, on September 15, 1943, while serving in the Army Air Forces. He was buried with military honors at Khartoum and received a posthumous award of the Order of Merit for Distinguished Service. He was an Industrial Member of the Institute.

Colonel Yeomans was a native of Cleveland, Ohio, where he was born October 15, 1904. He was graduated with the Bachelor of Arts degree from Williams College in 1927 and served as a flying cadet, graduating from Brooks and Kelly Fields in June, 1929, with the rank of Second Lieutenant in the Army Air Corps. He held a transport pilot's license and served as a pilot with American Airways from 1929 to 1930. From 1930 to 1935 he was statistician with James C. Willson and Company, North American Aviation, the Federal Aviation Commission, and Pan American Airways System. He held the office of Airport Manager and Section Superintendent with the Pan American Airways, and at the time of his return to active service with the Army Air Forces he was assistant to the Vice-President and Treasurer of that company. Throughout his civilian work he maintained his connections with military aviation, serving with the 27th Aviation Division of the New York National Guard and in the U.S. Army Air Corps Reserve.

Thomas Edward Moodie

Thomas Edward Moodie, Vice-President and Chief Engineer of Aviation Engineering, Inc., died on July 22 at the New England Baptist Hospital in Boston. He was an Associate Fellow of the Institute.

Born at Denison, Tex., February 28, 1900, Mr. Moodie received his B.S. degree in Mechanical Engineering from the Massachusetts Institute of Technology in 1924 and his M.S. in Aeronautical Engineering from the Daniel Guggenheim School of Aeronautics at Georgia School of Technology in 1934. He learned to fly at Squantum, Mass., in 1923 and held a Limited Commercial Pilot's rating. From 1924 to 1926 he was engaged in engineering work with the Public Service Electric and Gas Company in New Jersey; New Orleans Equipment Company, New Orleans; and the Electric Storage Battery Company in Philadelphia. During 1926 and 1927 he served as Assistant Professor of Applied Mechanics and Engineering Drawing at the Georgia School of Technology, and after a period of about 1½ years as Aeronautical Engineer with the Alexander Eaglerock Aircraft Corporation in Colorado Springs, he returned to the Georgia School of Technology as Assistant Professor of Applied Mechanics, Aerodynamics, and Airplane Design. From 1929 to 1936 he was Assistant and Associate Professor of Airplane Design at the Daniel Guggenheim School of Aeronautics at Georgia School of Technology. From 1936 to 1938 he was Vice-President, General Manager, and Chief Engineer of Trailcar, Inc.

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Aeronautical Engineer—a graduate engineer for work in postwar development division. Past experience should include performance studies, project design, including engine installations, and some operational knowledge. Broad acquaintance in air lines and manufacturing industry would be an asset. Only those who can secure a release will be considered. Give full résumé, references, and salary requirements. Address inquiries to Box 238, Institute of the Aeronautical Sciences.

Engineers, Industrial, for major coast-to-coast air line with procedural operating analytical experience, also comprehensive knowledge of the flow and control of forms and paper work. Must be willing to leave city—a permanent position, which offers unusual opportunity. Describe background fully. Enclose photo. Address inquiries to Box 239, Institute of the Aeronautical Sciences.

Industrial Engineers—major coast-to-coast air line, strong background accounting systems, operating cost accounting and capital items depreciation; must be willing to leave city. Permanent position offering unlimited opportunity. Describe background in detail. Enclose photo. Address inquiries to Box 240, Institute of the Aeronautical Sciences.

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Graduate Aeronautical Engineer—17 years of practical experience in military and commercial aircraft development, design, and supervision. Acted as consultant, project engineer, and designer in responsible charge of engineering work and personnel with major aircraft companies. Desire responsible and permanent position with aircraft company. Willing to accept position in South America or other suitable foreign country. Address inquiries to Box 245, Institute of the Aeronautical Sciences.

Mechanical-Aeronautical Engineer—5 years, major aircraft stress analysis. Desires connection with west coast air-frame or accessories company. Address inquiries to Box 244, Institute of the Aeronautical Sciences.

Layout Draftsman—21 years old, 2 years' experience in large aircraft factory in power plant and wing design; 2 years' experience tool and machine designing; recently honorably discharged from army. Desire position with postwar future in large aircraft company, preferably in vicinity of New York. Address inquiries to Box 243, Institute of the Aeronautical Sciences.

Helicopter Project Engineer—9 years' experience in aircraft engineering, composed of 1 year as project engineer, $6\frac{1}{2}$ years as structural engineer and $1\frac{1}{2}$ years as weight engineer. Desires position with a company sold on the future of this type of aircraft both for war and postwar use. Address inquiries to Box 242, Institute of the Aeronautical Sciences.

Rotary Wing Engineer; B.S. in C.E., 5 years' experience with leading aircraft manufacturers; 3 years as stress analyst and structural designer, past 2 years as rotary wing research engineer and helicopter designer. Thoroughly familiar with structural, mechanical, and theoretical problems of rotary wing. Desires position as project or design engineer on existing project or preparing original designs with responsible organization prepared to actively undertake helicopter development. Address inquiries to Box 241, Institute of the Aeronautical Sciences.

Inspector and Production Engineer—5 years' experience in high-altitude fighter planes, desires employment with transport air line having postwar future. B.S. degree; linguist; any location. Address inquiries to Box 237, Institute of the Aeronautical Sciences.

Graduate Engineer, 5 years' experience, varied, in production control, planning, cost estimating and control, tooling, engineering, weights, and aerodynamics. Permanently draft deferred, single, release available, present salary $7,000 per year. Considerable experience in writing and preparation of technical reports, specifications, and proposals. Over a year's experience in Helicopter engineering and dynamics. Wants responsible position, permanent, in production or engineering with reputable firm, preferably in East but will travel if necessary. Address inquiries to Box 236, Institute of the Aeronautical Sciences.

Structural Aeronautical Engineer—20 years' broad experience in all phases of military and commercial aircraft. Desires responsible position as development, liaison, or design project engineer with eastern company with postwar future. Address inquiries to Box 217, Institute of the Aeronautical Sciences.

Consultant Aeronautical Engineer recently discharged Army Air Forces, formerly executive Chief Engineer, desires additional consultant work under contract. Address inquiries to Box 205, Institute of the Aeronautical Sciences.

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To facilitate the prompt receipt of copies of the Journal and Review, members and subscribers are requested to give the editorial offices 30 days' notice of any change of address.

Notices should be sent directly to the Institute of the Aeronautical Sciences, 1505 RCA Building West, 30 Rockefeller Plaza, New York 20, N.Y.

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